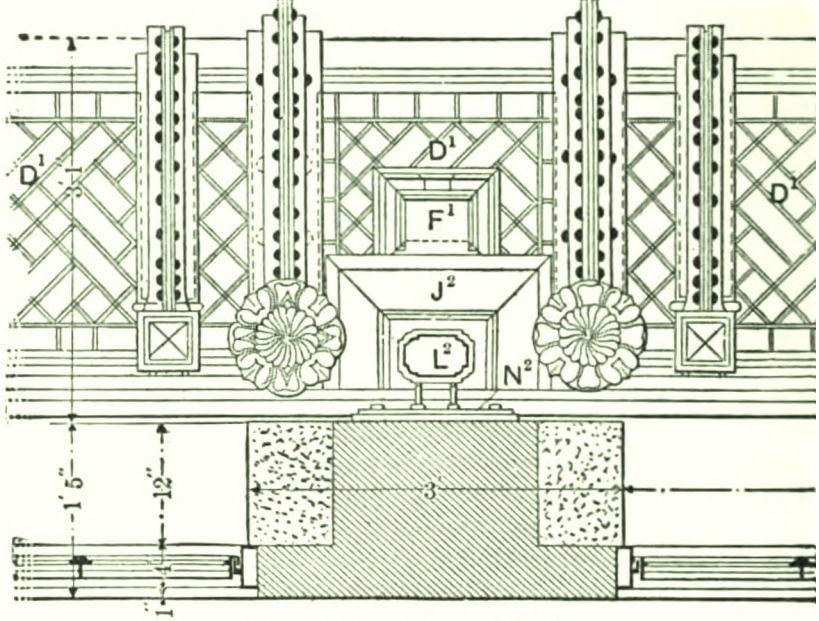
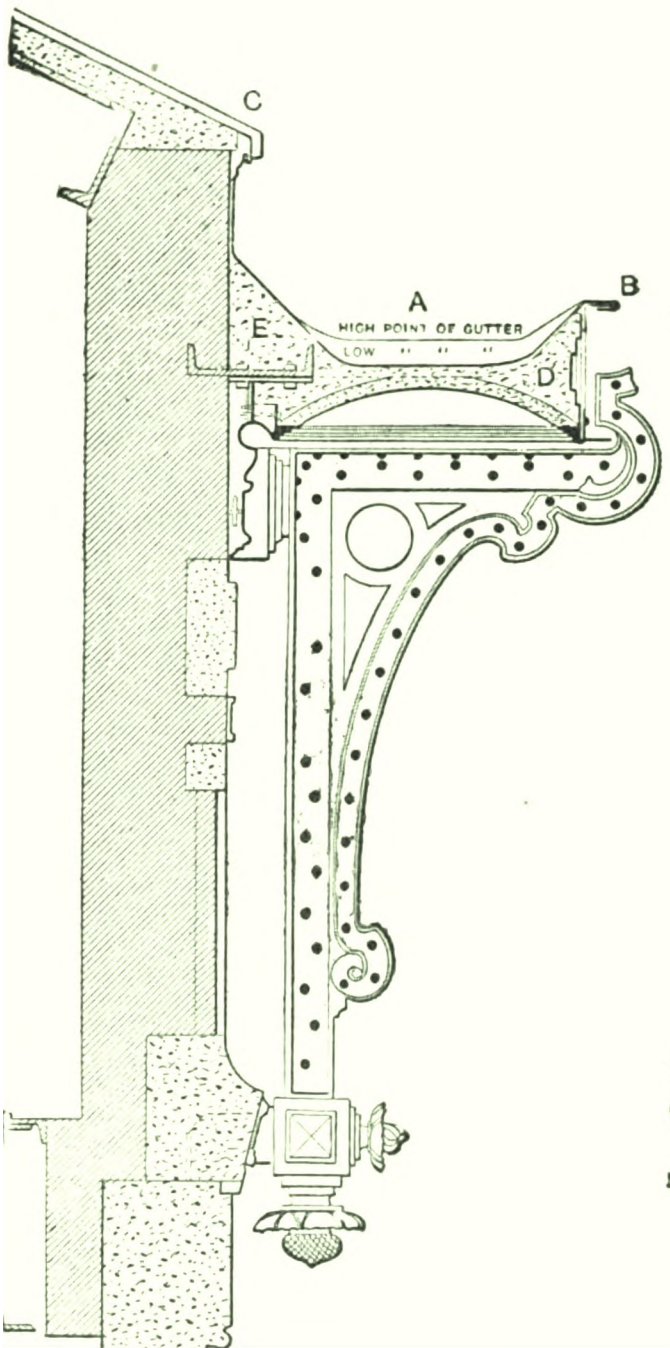
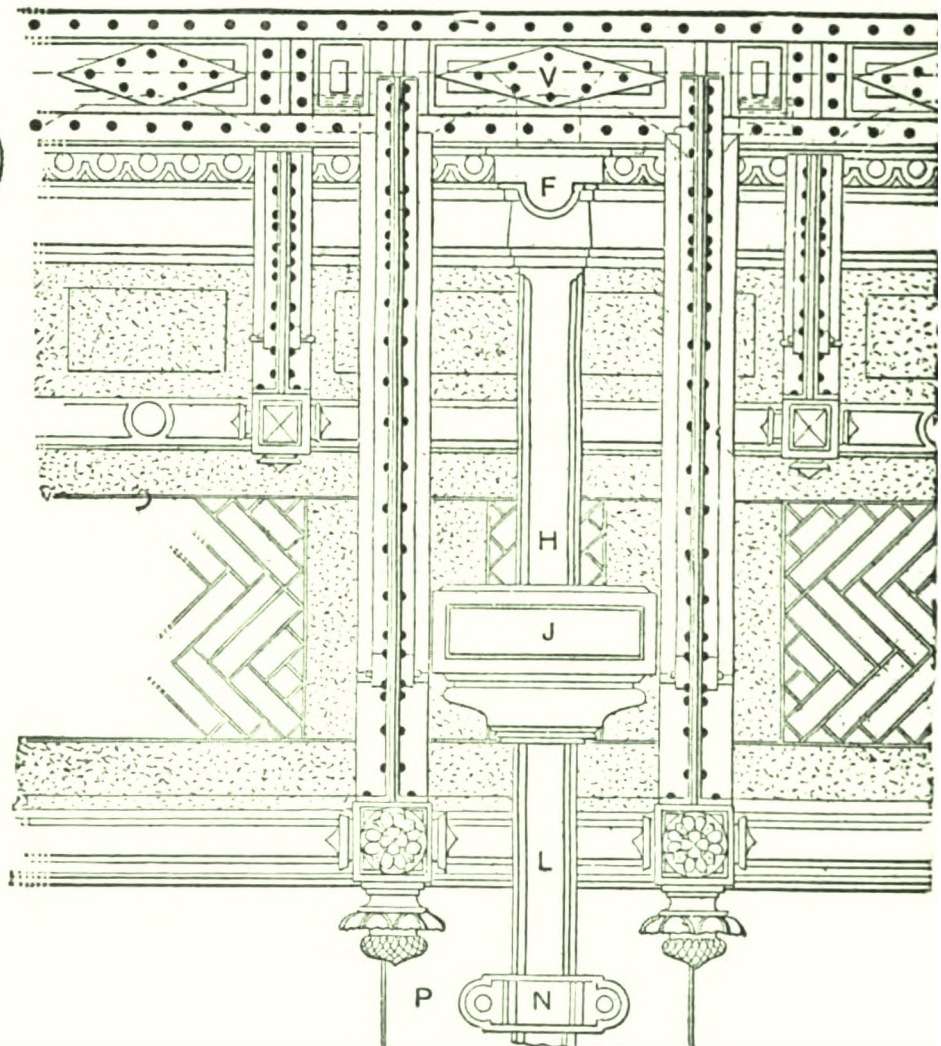


Fig. 132—Plan of Soffit





Practical sheet metal work and demonstrated patterns

John Henry Teschmacher

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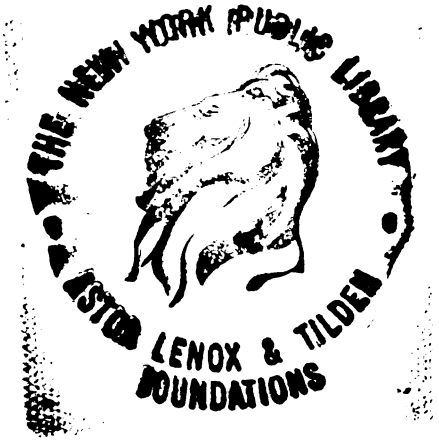

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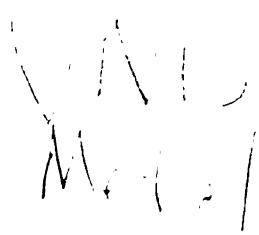

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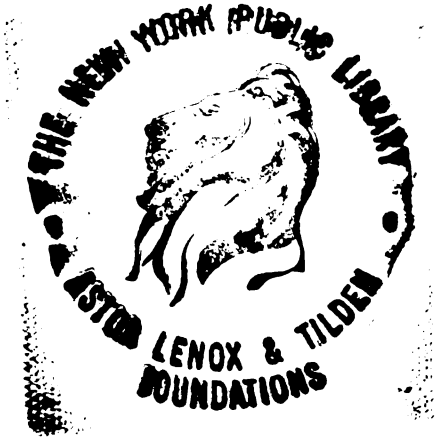

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PRACTICAL
SHEET METAL WORK
AND
DEMONSTRATED PATTERNS

A COMPREHENSIVE TREATISE IN SEVERAL VOLUMES ON
SHOP AND OUTSIDE PRACTICE AND PATTERN DRAFTING

VOLUME II
GUTTERS AND ROOF OUTLETS

COMPILED FROM THE
METAL WORKER
PLUMBER AND STEAM FITTER
EDITED BY
J. HENRY TESCHMACHER, JR.

DAVID WILLIAMS COMPANY
NEW YORK
1911

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PREFACE

THROUGHOUT its existence the METAL WORKER, PLUMBER and STEAM FITTER has had the services of experts in the lines the paper represented, especially so in the sheet metal trade and pattern drafting. The experience of these experts is used to answer queries of readers who, having a problem they cannot solve, resort to the columns of the paper.

Naturally then, a large collection of every-day problems has resulted and with the assurance by numerous inquiries that in book form these solutions would be invaluable they are compiled into a series to be known as Practical Sheet Metal Work and Demonstrated Patterns.

THE NEW METAL WORKER PATTERN BOOK has long been the standard authority on the science of pattern drafting and is thoroughly complete for one desiring to study the science of pattern drafting or to use as a reference book of such.

And as most of the problems appearing in the columns of THE METAL WORKER were essentially practical it was deemed advisable, instead of just taking those problems of pattern drafting and adding them to THE NEW METAL WORKER PATTERN BOOK and making no use of the practical articles, to compile these series which will virtually be AN ENCYCLOPEDIA OF PRACTICAL SHEET METAL WORK.

The first four books will comprise articles on conductors, conductor heads, roof connections, gutters, eave troughs, roofing, ridging, finials, cupolas, etc., etc. In all a valuable reference library for the progressive sheet metal worker doing roofing work.

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Inasmuch as in a compilation the work of many authors is selected, some under a pseudonym, no authorship can be given these books. The matter coming from a paper whose position of absolute authority on these subjects is undisputed should be ample recommendation. To the writers of the articles chosen sincere appreciation is expressed by the publishers. The majority of men from whom these articles emanate are not professional writers in the sense of devoting all their time to the production of printed matter, and thereby making their livelihood, but are actively employed at the trade and prepare these descriptions, expositions and demonstrations during spare time, often with no recompense than the knowledge that they are helping their fellow men; hence, too much credit cannot be given these authors' efforts, and it may be at least stated that the list includes: L. S. Bonbrake, H. A. Daniels, Henry Hall, George W. Kittredge, John W. Lane, William Neubecker, W. E. Osborne, C. T. Richards, H. Collier Smith.

J. Henry Teschmacher, Jr. (Henry Hall)

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Practical Sheet Metal Work and Demonstrated Patterns

ROOF OUTLET FOR INSIDE DRAIN PIPE

Fig. 1 is a sectional view of the outlet to connect to the inside drain pipe. A is the cast iron soil pipe, and this applies to screw pipe systems also, except that ferrule B, which is a brass sleeve, would be threaded instead of, as in this case,

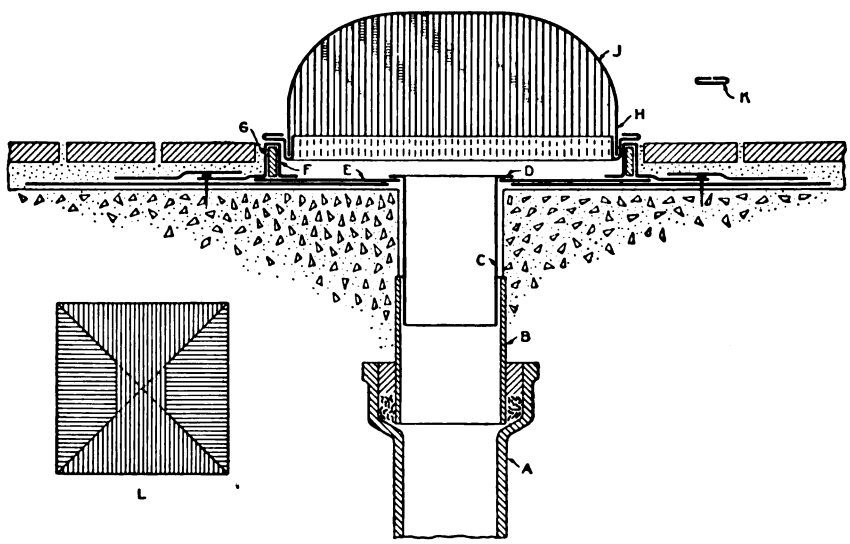

Fig. 1.—Details of Outlet to Conductor Pipe

caulked in. A copper tube C, is heavily soldered to B. This tube is generally in place before the outlet is set on roof so a hole is cut in box just big enough to admit the tube.

The tube is trimmed within, say $\frac{3}{8}$ of an inch of the bottom of outlet, flanged, at D, and carefully soldered, for, despite numerous attempts to devise other methods this still prevails. It is obvious that this is the weak point and on highest grade jobs cast copper outlets with the tube integral are required.

The outlet box consists of a square sheet of copper, E, and the sides, F, which are bent as shown and soldered to the sheet E and reinforced with a core of band

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iron, G. The box is nailed to the ash concrete of the roof through the waterproofing and made watertight with more felt and tar. Then flat tiles of roof are laid in cement.

The strainer of the outlet is made of four sides formed, as shown at H, and the basket part consists merely of strips of copper bent, as indicated at K, and shaped to fit the desired contour. The diagram at L, which is a plan view, gives the idea of the manner of assembling the strips having the hips of wire. The strainer is usually just set in the outlet but if required can be hinged, by wiring, H, with sheet metal hinges and soldering hinges to outlet.

CAST COPPER ROOF DRAINAGE HEAD

There always has been considerable trouble with the conventional inlet of sheet metal to the rain-water conductor. The manner of connecting the tube to

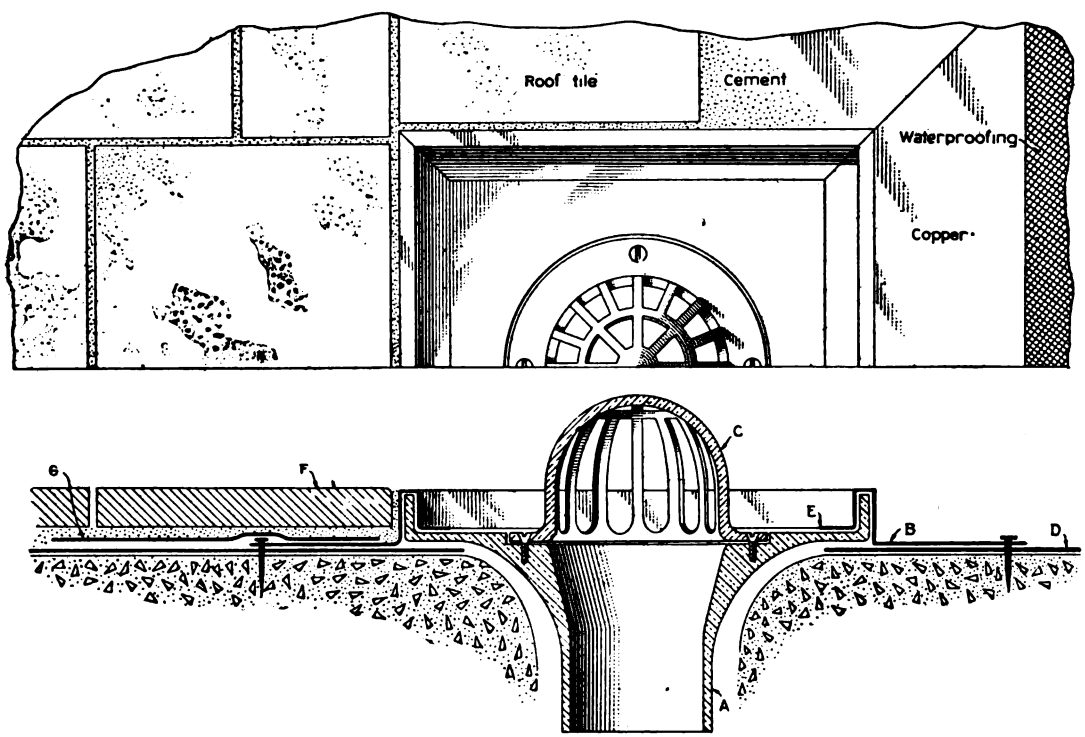

Fig. 2.—Construction and Method of Installing Roof Drainage Head

the inlet certainly violates the teachings of experience in roofing, which tells us that all seams shall be made so as to have the water flow over the seam. In the

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majority of cases, after carefully seeing to it that all seams are as stipulated, we insert the tube in the box or gutter with a flange turned out against the water coming from the entire roof. When this flange tears from the outlet, for this is within the range of possibility, the water soaks through this broken connection into the building.

Architects now realize that what should be the strongest part of the roofing is the weakest and specify that the tube shall be integral with the inlet box. About the only way to accomplish this is to have them cast in one piece. The accompanying drawing Fig. 2 shows how a cast copper or brass inlet, or outlet as some call them, is applied to roofing.

The box and tube are shaped to have ample strength at the connecting point and the sides are made to act as a guard for the flat tiles F or the gravel of the roofing.

A sheet metal flashing, B, is bent to fit over these sides and turned 6 in. out on the roof. This flashing is heavily soldered to the outlet box at E. The box is set in place and the flashing nailed to the ash concrete through the waterproofing D and made watertight with more felt and tar, G, after which the tiles are laid.

The strainer C is also cast copper and secured to the outlet box by screws as shown. Most any design will do for this strainer, only bearing in mind that the apertures shall be small enough to intercept objects as small as a pebble.

Connecting this outlet to the drain pipe is properly within the province of the plumber. But, while this tube A can be either caulked direct to the cast iron conductor pipe or a thread cut in it for screw connection, it is suggested that a flexible rather than this rigid connection be used, such as a lead elbow with wiped joint to the tube A.

After the pattern is made these outlets would not be costly in comparison with the unsatisfactory sheet metal ones, when considering the fact that on buildings where the best roofing is required they give complete assurance of no leaks by bursting tube or connections.

WATER SPREADER FOR STEEP ROOF

It is often the case that the rain water from an upper roof is drained through leaders on to a lower roof. When the latter is very steep and the upper roof has a large surface the rain water in a storm or shower rushes through the leader and out of the elbow, shown at C, Fig. 3, and in some cases the force of the rush not being broken it is apt to flow or spray over the gutter D, shown in the side view.

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To avoid this and to break the rush of the water there is shown in Fig. 4 a view of a water spreader with dimensions. The spreader is riveted on a sheet of tin, copper or sheet iron, as required. If the roof is of tin or copper a lock is edged on

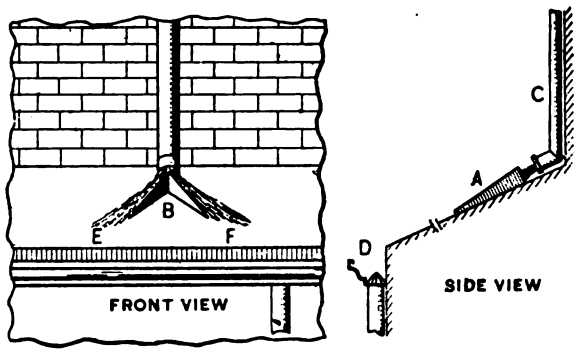

Fig. 3.—Water Spreader for Steep Roof. Front and Side View of Water Spreader

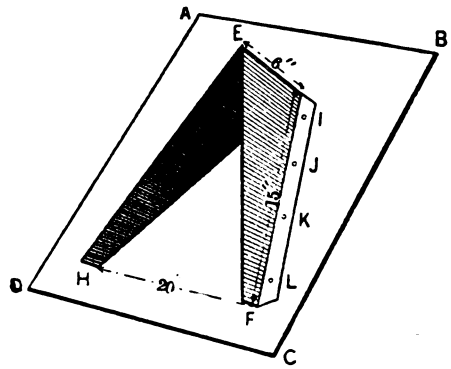

Fig. 4.—General View of Water Spreader as it would Appear on a Steep Roof

to the sheet A B C D and laid in with the courses, while if the roof is of slate or wood shingles the spreader is fastened to heavy galvanized sheet iron and slated in with the courses. E F H represents the spreader, being 6 inches high, 15 inches long and having 20-inch spread, and is riveted at I J K L on each side. In Fig. 3 is shown the method of placing the spreader in position, A being the spreader in side view and B in front view. The water rushing through the leader C is cut by the spreader, throwing the water in either direction at E and F, then flowing into the gutter D.

ANOTHER WATER SPREADER

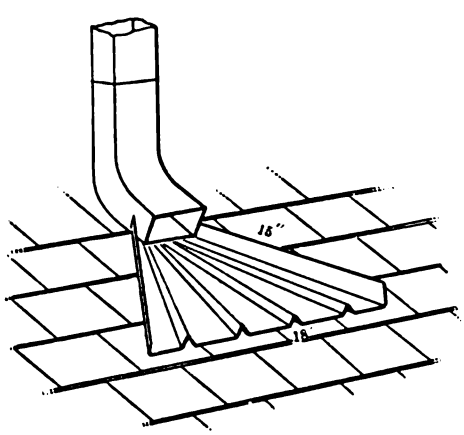

Fig 5.—A Water Spreader for Roofs

Another simple and inexpensive spreader, as shown in Fig. 5, of copper or galvanized iron may be made on any brake or bending machine of a width and length to suit the conditions. The effect is to spread the water out in a thin sheet, and the shape of the spreader is such as to be proof against injury by ice forming on it. By its use all trouble from water penetrating the spaces between the slates or shingles is avoided.

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ROOF WITH SINGLE LEADER

A few suggestions regarding a gutter for a roof like Fig. 6, are that the gutter should be almost level for some distance from the starting point and then made to

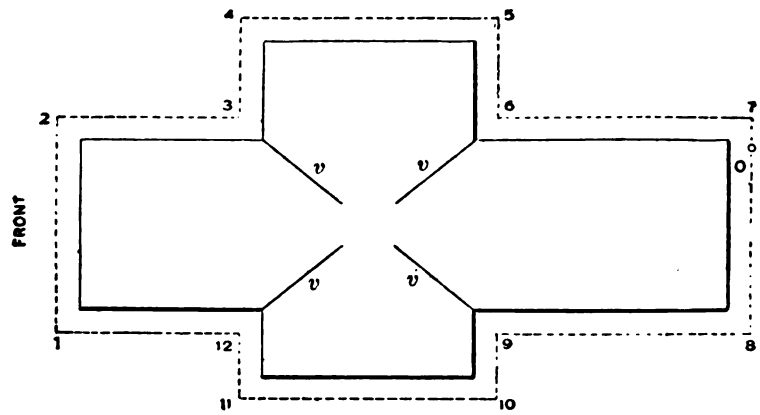

Fig. 6.—Roof with Single Leader Pipe. Plan of Roof.

incline toward the outlet, this last half being enlarged if possible. The inside miters, as 3 or 6, should be made rounding or "octagon," as shown in Fig. 7, which would help the flow of water to a considerable extent. In this figure A B C D E F G represents the gutter in plan and J K in profile. By placing the gore piece as indicated by F H E the trough would be wider at the bend. It is suggested that

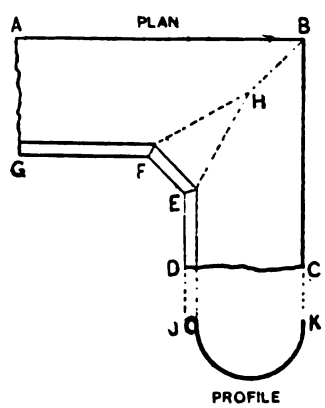

Fig. 7.—Proposed Form of Inside Miter

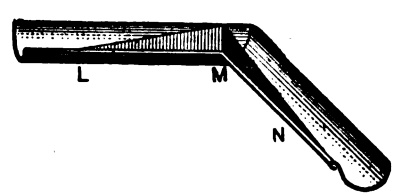

Fig. 8.—Guard for Inside Miter

upright pieces of tin or guards be soldered to the bead of gutter at the inside miters 6 and 9. The pieces, as shown in Fig. 8 by L M N, could extend each way from 18 inches to 2 feet and be 2 or 3 inches high at the center M, tapering each way to

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L and N. If desired the miters at 6 and 9 could be made as indicated in Fig. 7 and provided with guards similar to Fig. 8, being bent so as to conform to the shape shown by G F E D of plan.

AN ESSENTIAL FEATURE IN GUTTER CONSTRUCTION

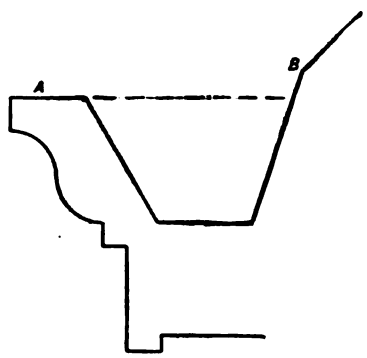

Fig. 9.—An Essential Feature in Gutter Construction

In any gutter it is within the range of possibility of the outlets becoming clogged from various causes. Hence it is necessary to bear this in mind when designing gutters, etc., and have them so constructed that in the event of the outlet becoming stopped up the water will flow over the face of the gutter or cornice and not back up on the roof and under the slates, shingles or cap flashing and into the building. In short, the rule to be followed is to have the point A, of Fig. 9, lower than the point B.

INSIDE MITER OF A GUTTER—A GORE PIECE

It is obvious that a considerable flow of water occurs in the valley of a roof and if this water is discharged into the internal angle of a gutter it is apt to splash over the sides of the gutter, the more so if the roof is very steep.

And as the water flowing in the gutter makes the turn in an inside miter it very often, owing to the sharpness of the turn, banks and runs over the gutter.

Therefore if we make the miter as we would a three piece elbow an easier turn is provided and also a gutter wide enough at this point to take care of all the water flowing from the valley.

The diagram Fig. 10, shows an eave trough with a right angle inside miter and the gore piece A. The size of this gore piece is a matter of choice and the same principle of obtaining patterns applies for any angle.

The method of developing the patterns is to place the profile of the gutter as shown, and in its proper position the plan. Having decided on the size of the gore the line B D is drawn with the 45° triangle and angles B and D bisected as shown.

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For other than a right angle miter the correct position of the line B D is found by bisecting the angle and drawing B D perpendicular to the bisecting line.

As in many cases of pattern cutting the miter lines can be arbitrary, providing no rules of geometry are violated. In this instance the bisecting lines of angles B and D were terminated on the bottom line of the profile as C and E thereby realizing the plan of the gutter miter.

The profile is now divided into convenient spaces as 0 to 19 and these points dropped to the miter lines as shown.

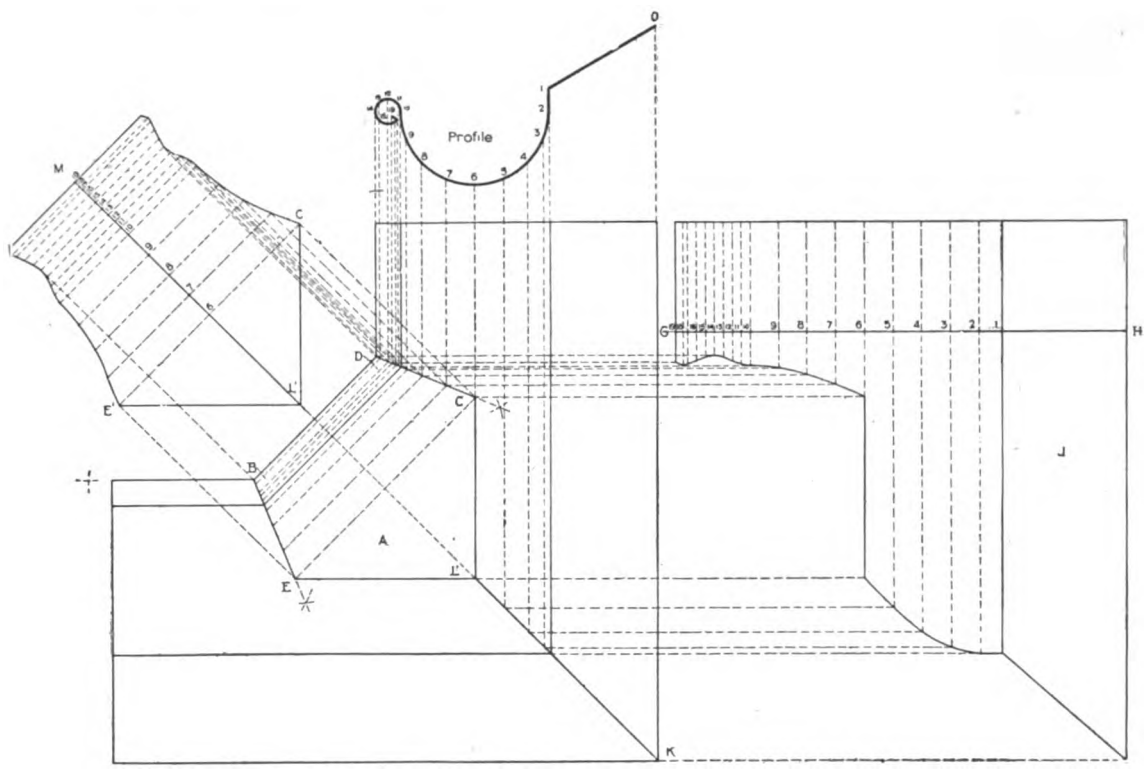

Fig. 10.—Inside Miter of a Gutter—A Gore Piece

On the line G H place the stretchout of the miter profile and project lines from like points on the miter lines as is customary. Then will J be the pattern of the gutter.

Extend the line K L to M, and on this put a reproduction of the triangle piece of the gore E C L as E^1 C^1 L^1, and call line E^1 C^1 number 6. Then from this on line L-M, place the rest of the stretchout of profile to 19, and from miter lines draw lines to intersect like numbered lines which will give the pattern of the gore A.

When allowing the laps have them on the patterns so that the water will flow over the joint and not against it.

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FALSE BOTTOM FOR GUTTERS

All the gutters must obviously have a pitch or fall to the outlet and in the hanging type, such as eave trough, this fall is perceptible from the ground. Often if the fall is pronounced it is an eyesore to observers.

To overcome this the molded face styles are made level throughout and a false bottom soldered in which has the necessary fall to the outlet. Considerable

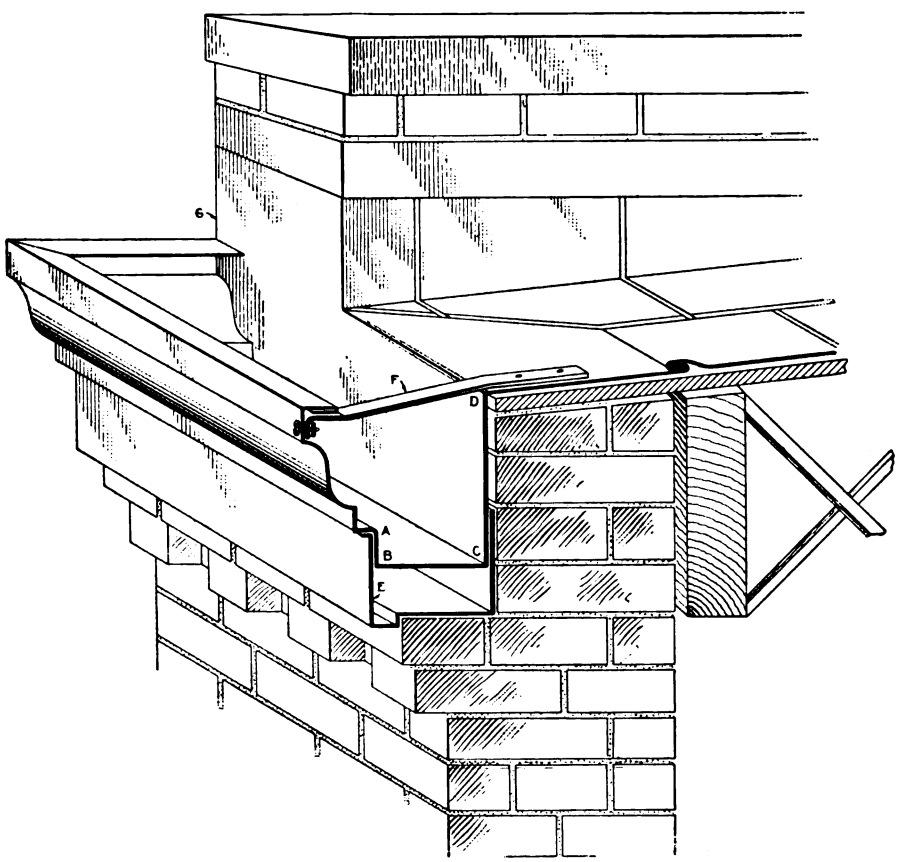

Fig. 11.—Details of a Gutter with a False Bottom

trouble is experienced with these bottoms owing to their breaking from the sides of the gutter despite rivets and soaking in the solder.

Inasmuch as these gutters are intended to be ornamental, Fig. 11 illustrates how this ornamentation can be enhanced by extending a few of the stretcher courses of the brick work and by alternating the bricks of the header course one in one out, an appearance of dentil blocks is obtained.

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The gutter proper can have the required pitch in the vertical members A B and C D, and the fascia piece E made separate and with a drip as shown. This fascia piece is soldered to the gutter and as gutters are usually made of heavy material, this fascia piece can be one or two gauge lighter.

At the lowest point or outlet the bottom of the gutter will be down to the horizontal line of the fascia piece which rests on the brick work. The outlet tube is put in and soldered in the customary manner and would either connect with a leader on the outside or the inside of the wall.

The braces F are of galvanized or tinned band iron $\frac{1}{8} \times 1$-inch stock, bolted to the front part of the gutter and riveted to the roof flange of gutter as shown. These rivets are soldered watertight on the under side. If, instead, it is specified that these braces be attached after the setting of the gutter and nails driven through to the roof sheathing, then the entire brace must be soldered to the roof flange of the gutter to prevent leaks through the nail holes. These braces are made all alike and spaced 2 feet apart.

The gutters are made in a length on the crown line from the outer edges of the fire or battlement walls G. At the inner lines of the walls the roof flange of the gutter is cut and flattened out and forms a flashing which goes up and under the cap flashing that was built in with the wall. The wall flashing connects with this flashing of the gutter as shown by the illustration.

Should the wall flashing be very high at the outer edges of the walls, use some roofer's paint skin and secure it to wall with hooks to keep rain from blowing in behind the flashing at G. A much better method would be to step the flashing into the brick work.

BRACES FOR EAVE TROUGH

The illustration herewith, Fig. 12, is a sectional view showing how eave trough can be fastened. A represents the roof boards, which should not be less than $1\frac{1}{4}$ inches in thickness, and grooved out as shown, so as to admit the bottom brace B. This brace is made from 3-16 $\times$ $1\frac{1}{4}$-inch band iron, screwed to the roof boards with screws B′ B′. After all the bottom braces have been fastened, the gutter C is laid in the bottom braces and securely pressed into them, after which the top brace D is bolted to bottom brace B, as shown at E. In this manner the gutter is held in position by the bolt E. The top brace is screwed to the roof boards, as shown by F, which at the same time holds the flange of the gutter in position,

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shown by C′. This flange of the gutter C′ should extend up high enough under the slate to insure a tight job. H H indicates the first slate and shows how the slate should overlap the screws so as to avoid a leak.

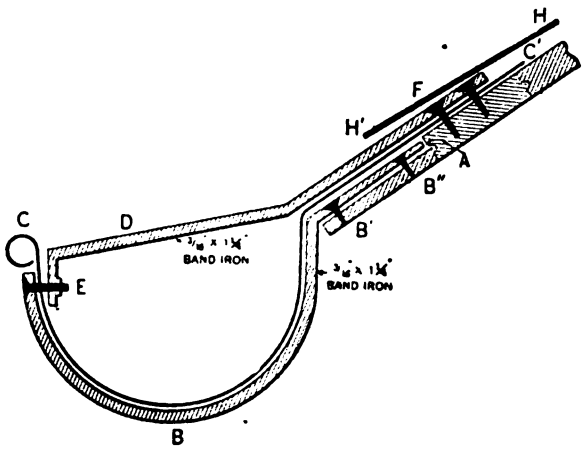

Fig. 12.—Fastening Eave Trough

In bending the top and bottom braces proceed as follows: Measure off the length of the brace required, which can be done by taking a strip of tin and laying it around the outside of the gutter, as shown in Fig. 12. Cut off as many pieces of band iron to the required length as there are braces required. In forming the bottom braces roll them through the stove pipe former or roller until they have the required circle, after which place the brace in a vise and bend off the flange to the required angle, as shown at B′, Fig. 12. One-quarter inch holes are now punched by hand or machine, where shown, so as to admit the bolts and wood screws. The top braces are made in the same manner and ¼-inch holes punched in them for bolts and wood screws. When this gutter is completely finished it will sustain quite a pressure. The snow sliding from the roof obtains quite a hold in the gutter and the braces prevent the gutter from breaking down.

COMPLETE INSTRUCTION ON A ROOF OR SNOW GUARD GUTTER

In Fig. 13 is shown a section of a roof or snow guard gutter, also the method of slating it. To give a better explanation of this diagram the method of starting a slate roof will be explained. As this is a little out of the line of cornice work, it is better if we understand it in case the slate roofer would desire to know how many courses he should slate before the gutter is put on. Before starting a slate roof the roofer should see that a cant strip is nailed about 1 or 2 inches above the eave line of slate, as shown at F, Fig. 13. This strip should be about ¼ inch in thickness and 1½ inches wide, the ordinary plaster laths being satisfactory. If the slates used are 8 × 16 inches in size, the first course should be laid the

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16-inch way, or, in other words, the length of the slate should be laid parallel to the eave line of the roof. The second course and all others should be laid the 8-inch way. In laying the 8 × 16 inch slates it is usual to lay them 6 inches to the weather, by which is meant the second course will overlap the first 10 inches and the third course will overlap the first 4 inches. Let E, in Fig. 13 represent the leader, which we desire to place in the position as shown. The place of the leader being decided upon at once gives the position where the lowest point of gutter will be placed and the number of courses of slates required. Referring to Fig. 13, it will be seen that the slater must put on four courses of slate, counting the course under eaves (if the leader was placed higher or lower the number of courses of slates would be more or less, respectively). After the lower four courses of slates are in place the slater must stop until the gutters are set. It is usual to give about 4 inches pitch to about 20 to 25 feet of gutter.

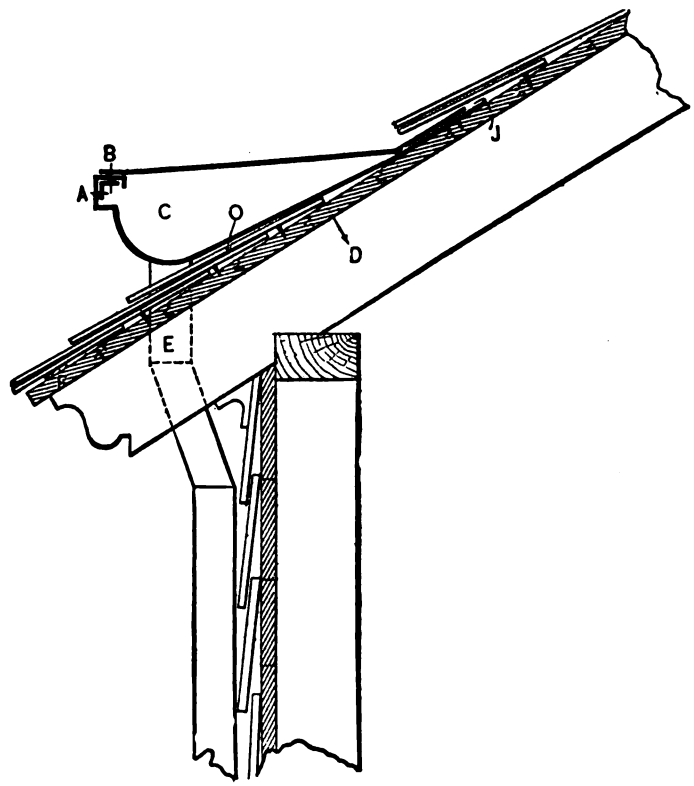

Fig. 13.—Section of Snow Guard Gutter, Showing Method of Slating

The style of gutter shown in Fig. 13 has an angle iron of $\frac{1}{4} \times 1\frac{1}{4} \times 1\frac{1}{4}$ inch in size and lighter, bolted through the galvanized iron gutter and top brace. The top braces are usually bolted about 30 inches from centers, and are made of 3-16 or $\frac{1}{4} \times 1\frac{1}{4}$ inch or 1-inch band iron respectively, and are galvanized after being made.

In putting up this form of gutter the angle iron is left out until the gutter has been placed in its proper position on roof and tacked with a few roofing nails, as shown by A and B, Fig. 16. After the gutter is set to the right pitch the angle iron is pressed up into the inside top edge of the gutter and held in position with a few hand vises, as shown in Fig. 14, until the bolts are inserted, after which the hand vises are removed. If a punching machine is not at hand, the holes in the angle iron

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and the top braces can be punched by hand by having a female die placed on a solid block of iron or wood, so that when the punch is being driven from the top there will be no springing.

The holes in the top braces to receive the wood screws can be countersunk by means of a breast drill if a machine is not at hand. The breast drills, including the punches and dies, can be purchased of any dealer in tinners' and cornice makers' tools. After the top braces are bolted to the angle iron at B, Fig. 13, a wood screw or two is screwed through the top brace at J. The slate roof is then started again, in the same manner as described for the eaves.

If the roof covering, as shown in Fig. 13, were to be of shingles the same rule would be followed as for slate. If tin were used, then tin up the roof as far as shown at D, Fig. 13, and set the gutter in its right position. As the gutter is to

Fig. 14.—Angle Iron held in Position with Hand Vise

Fig. 15.—Lap on Corrugated Iron Roof

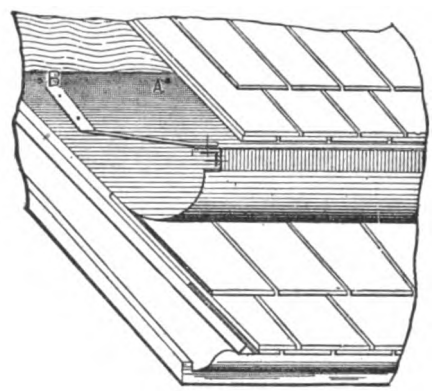

Fig. 16.—Perspective View of Roof or Snow Guard Gutter, Showing Angle Iron and Brace

set to a given pitch, the upper edge of the gutter J, Fig. 13, would be cut on a straight line struck by means of a chalk line and chalk, and then a lock attached, as shown at J K, Fig. 20. The tin is now locked on to the flange of gutter and the roof tinned up.

If the roof were of corrugated iron, the sheets would be allowed to extend up as far as D, Fig. 13. The gutter would now be set to the proper pitch, on the top flange of which a lock would be made, as before described, it not being necessary in this case to cut the flange straight. This lock would prevent the snow from driving up under the corrugations. In laying a corrugated iron roof as much lap should be given as is shown in Fig. 15. In tile roofing the same method would be employed as described for slating.

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It is very advisable, if the roof covering is of slate, tile or shingles, to lay a sheet rubber cushion, not less than 3-16 inch in thickness, between the bottom of the gutter and top of the slate, tile or shingle, as shown at O, Fig. 13, to prevent breakage in case a large amount of snow would slide into the gutter. The rubber should be as wide as the part of the galvanized iron flange of gutter that lies against the slate.

Fig. 16 is a perspective view of roof or snow guard gutter, showing the slates in position above and below the gutter, also the angle iron and brace bolted in position, and top brace screwed on the roof board, through the gutter flange.

Let us assume that the gutter is to be connected to a round leader. In Fig. 17 is shown the method of obtaining a watertight joint on roof, with the use of sleeve, tube and leader, and in Fig. 18 the improper method of making a joint, with the use of the tube and the leader only. It is of great importance that this method of putting in the sleeve be understood, as by not using the sleeve a leak is often the result. In Fig. 17, let A represent the sleeve, B the tube and C the leader. It will be noticed that both the sleeve and tube go inside the leader, so that in case the snow drives against the angle E and thaws it must drip inside of the leader; while, as shown in Fig. 18, the snow driving against the angle E

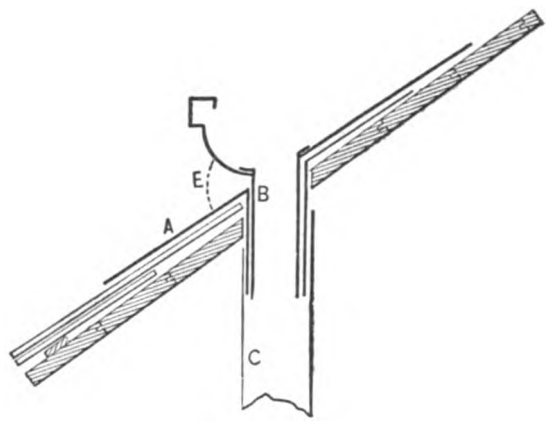

Fig. 17.—Proper Method of Water tight Joint with Sleeve, Tube and Leader

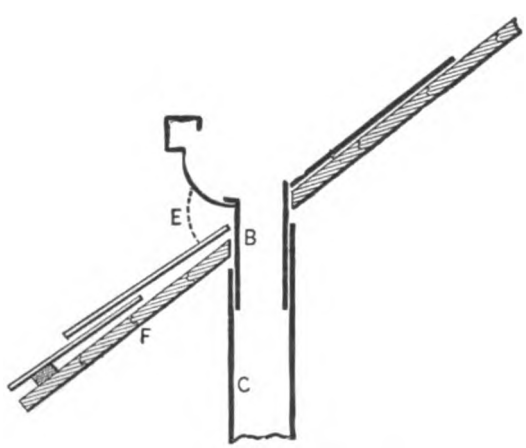

Fig. 18.—Improper Method of Making a Joint

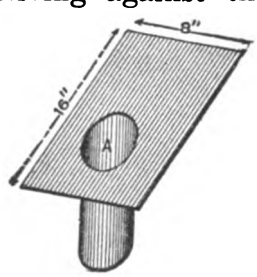

Fig. 19.—Metal Shingle with Sleeve Attached

when thawing, soaks through the woodwork F and rots it at every storm, because the tube B only connects to the leader C. In Fig. 19 is shown a perspective view of a metal shingle having sleeve attached. These shingles are to be cut to the size

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of the slates used, in this case 8 × 16 inches, and laid in with the course, where the roofs are covered with slate, tile or shingle. The sleeve shown at A, Fig. 19, should be soldered to the shingle where required; that is, just according to how the leader would be situated. In case the leader is so situated as to strike the bottom, center or upper part of slate, the sleeve A would have to be placed accordingly.

At P, in Fig. 20, is shown a shingle with sleeve attached, slated in as required, the leader having in this case cut the shingle in the center. The tube of the gutter passing through the sleeve connects to the leader below at F. In fastening the

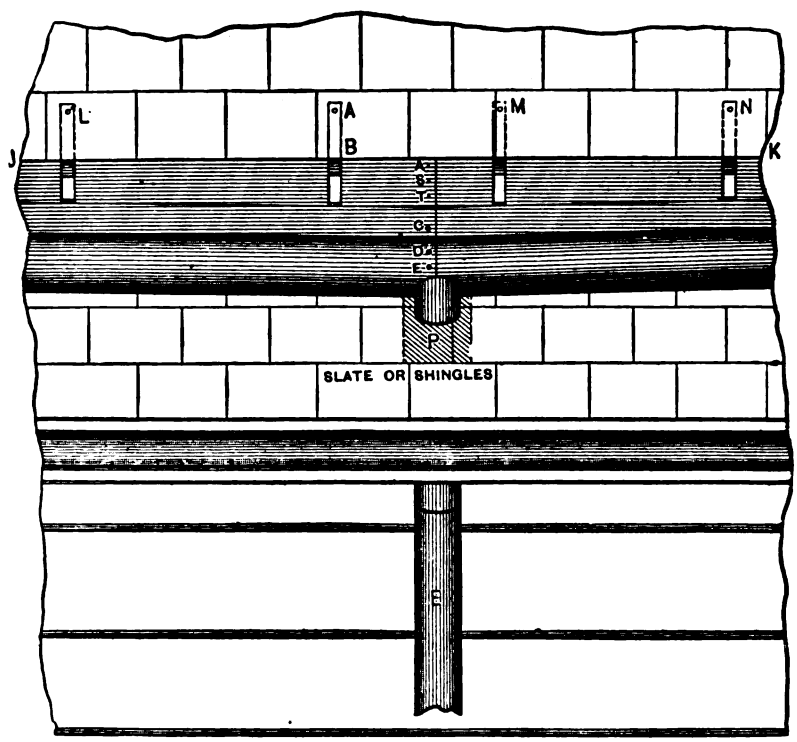

Fig. 20.—Front View of Roof or Snow Guard Gutter

leader F the ordinary hooks are used, which can be made by any blacksmith or purchased of dealers in tinners' supplies. There are different forms of leader hooks and fastenings with ornamental coverings.

In Fig. 20 is shown part of a front view of a roof or snow guard gutter, finished complete, the section of which is shown in Fig. 13. L A M and N represent the braces bolted to the gutter and screwed to the roof; B is the bottom edge of the slate or shingles; C D and E are rivets to reinforce the soldered joint, and

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likewise A S and T the tinned or brass wood screws screwed into the roof boards through the flange of galvanized iron and soaked well with solder.

Having understood how the snow guard gutter is to be constructed, the measurement and bevel of roof must now be obtained from the building. Brass and wooden bevels can be purchased from hardware dealers, but a bevel constructed of band iron will answer just as well.

In Fig. 21 is shown what is required to construct a bevel of band iron. Let A represent one of the two pieces of band iron, with a ¼-inch hole punched and countersunk, as shown at D, to receive the rivet, and B the section. C represents a ¼ × 5-8 inch rivet, which is used to rivet the two pieces of band iron together. Care should be taken that when the two arms are riveted together the one is exactly like the other and that the end E is perfectly square.

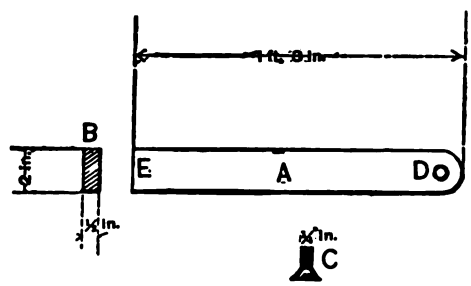

Fig. 21.—Rivet and Band Iron for Bevel

When the bevel is finished and is in use it will look as shown at L, in Fig. 23. Fig. 22 is the front elevation of roof and gutter, also showing the method of obtaining the working measurements.

Let the width of the building on which the gutter is required measure 42 feet as shown, and as the leader P is to be in the center of the building, divide the width by 2, and 21 feet on each side is the result, as shown. The pitch, or fall of the gutter, will come directly over the leader, as shown by X, Fig. 22.

From the point X, Fig. 22, or the lowest point of the gutter, strike a chalk

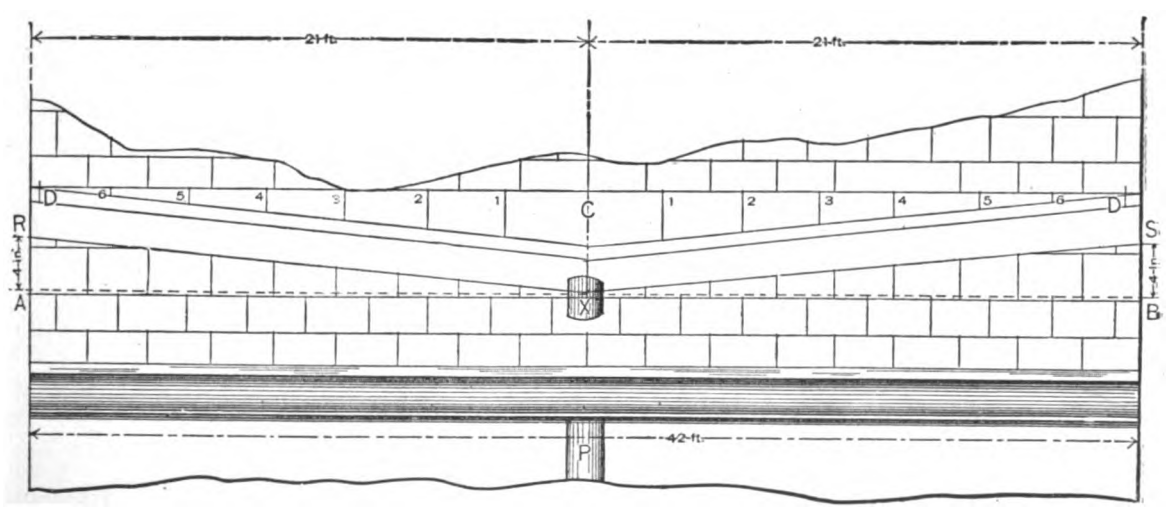

Fig. 22.—Front Elevation of Roof and Gutter

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line parallel to the eave line, as shown by the dotted line A B. At right angles to the line A B, on either side, measure up 4 inches, or the pitch of the gutter, on a perpendicular line, as shown by R and S, Fig. 22. Now strike a chalk line, S X and X R, which gives the bottom line of the gutter, shown on the section in

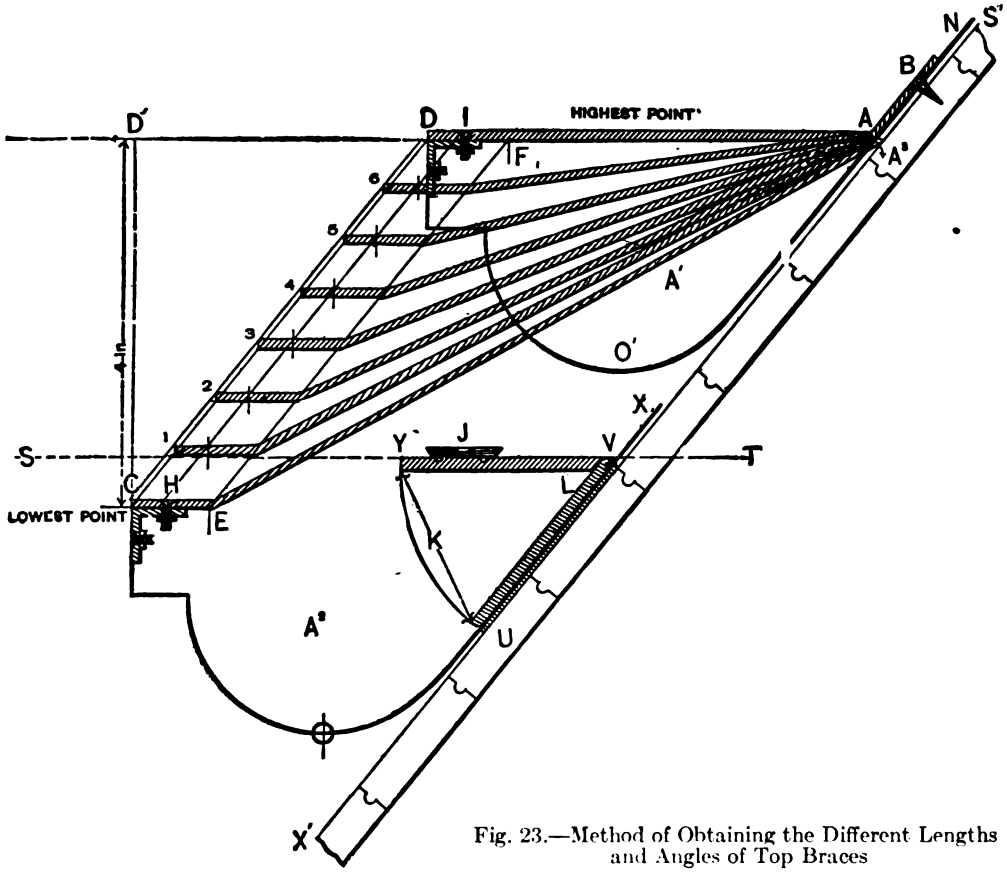

Fig. 23.—Method of Obtaining the Different Lengths and Angles of Top Braces

Fig. 23, at O. The line R X and X S would be struck on the top of the slates, or whatever the covering of the roof may be, and upon this line the bottom line of the gutter would be placed.

Having now obtained the length of each side of the gutter, the next step is to obtain the bevel of the roof. To do so, place the bevel as shown by U V Y in Fig. 23 the arm U V being placed against the roof and the other arm, V Y, being raised or lowered until level, which can be proved by screwing a small spirit level on the arm, as shown at J. Now measure the distance between the arrow points K, and the bevel can be closed and opened again when required to the distance before obtained. This bevel forms the basis of measurements required to construct the different braces shown in Fig. 23.

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In setting up work of this kind it is well to make a rough diagram, similar to Fig. 22, showing the braces required and their numbers, also the pitch the gutter is to have, for the use of the mechanic who sets up the work. As the braces are of different lengths (to obtain a straight line, as shown from D to D in Fig. 22), each brace will be numbered in the shop to correspond to the numbers shown on the braces in Fig. 22 by C, 1, 2, 3, 4, etc.

In Fig. 23 is shown the method of obtaining the different lengths and angles of braces. Draw any horizontal line, as shown by S T, indefinitely, upon which place one arm of the bevel Y V; now open the bevel to the length obtained between the arrow points K, as before explained, and draw a line parallel to, and against the arm of the bevel U V, as shown at X′ S′. Then X′ S′ will represent the roof line and S T the horizontal or level line, corresponding to the bevel U V Y. Now draw a section of the gutter, as shown by A′, Fig. 23, care being taken to have the top of the flange of the gutter, as shown at N, high enough above the top of the front of the gutter, so that in case the leader stops up, causing an overflow, the water will flow over the front of the gutter, and not behind the flange N and into the building.

As the pitch of the gutter is 4 inches on a perpendicular line, as shown in Fig. 22, measure down 4 inches from D′ to C, Fig. 23, and draw a duplicate of the section of the gutter A′, as shown by A^2. Then D will represent the highest point of gutter and C the lowest point, as shown. The sections of angle iron, with bolts through the top braces, are shown at I and H. Draw the brace at the highest point of gutter horizontal, as shown from D to A, with an angle attached to screw to the roof board, as shown from A to B. Then draw the brace for the lowest point of gutter horizontal from C to E, or as much as there is flange on the top of the gutter. Connect the points from E to A^3 and add the thickness of the brace, as shown, which in this case is 3-16 inch.

Then D A B, Fig. 23, will represent the top brace D, Fig. 22, and C E A^3 B the center or bottom brace C, shown in Fig. 22. As the pitch of the gutter is 4 inches and the projection of the roof on 4 inches as much as shown from D to D′, Fig. 23, and as there are eight braces required on the 21 feet of gutter, as shown by C, 1, 2, 3, 4, 5, 6 and D in Fig. 22, it is self evident that each brace will be of a different length and angle.

To obtain the different lengths and angles proceed as follows: Draw a line from C to D, Fig. 23, as shown, and divide this line into seven spaces, or as many spaces as there are shown between the braces in Fig. 22. Now draw a line from

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E to F, which intersect with horizontal lines drawn from the small figures on the line C D. From the intersections obtained on the line E F draw lines to the corner A. Now add the thickness of the brace, as shown, and draw lines parallel to the horizontal lines 1, 2, 3, 4, 5 and 6, intersecting the line E F, and from these intersections draw lines to the corner A^3. Then the braces C, 1, 2, 3, 4, 5, 6 and D in Fig. 23 will represent the braces used on each side of the gutter of corresponding figures shown in Fig. 22. A line drawn from H to I, Fig. 23, will give the points where the holes are to be punched for the bolts; the angle A B will be the same length on all the braces.

After the braces are bent to the required angle and numbered, they are usually galvanized to prevent rusting; the angle iron also is usually covered with two coats of metallic paint before it is inserted in the gutter.

Fig. 24 is a section of a roof or snow guard gutter, the bends of which have been made square, so as to avoid a confusion of lines in obtaining the patterns; although the principles used are the same no matter what form or shape is taken. To obtain the plan and elevation proceed as follows: Let N S, Fig. 24, represent the line of the roof; C, the highest section of gutter, and D the lowest section. Let A B or H F represent the pitch of the gutter on a perpendicular line and E F the projection of same. Let R S U T, Fig. 25, represent one-half of the plan of the roof, the width of same being 21 feet. Now draw any line parallel to the eave line of roof, or T U, as shown by V W; take the distance of the projection of the gutter, shown by E F in Fig. 24, and place same at right angles to V W, as shown by V X, Fig. 25. Now draw a line from X to W, as shown. At right angles to the line X W place in the proper position, as shown at A, a duplicate of the profile or section of gutter shown at C or D, Fig. 24. Number the bends of the profile A, Fig. 25, as shown by the small figures 1, 2, 3, 4, 5, H and 6. Now parallel to the line X W draw lines through the numbered bends, cutting the lines R T and S U, as shown. Parallel to the line X W draw a line indefinitely, as shown by X′ W′. At right angles to the line B D in plan draw lines upward from B and D indefinitely, as shown by B C and D E, cutting the line X′ W′ at

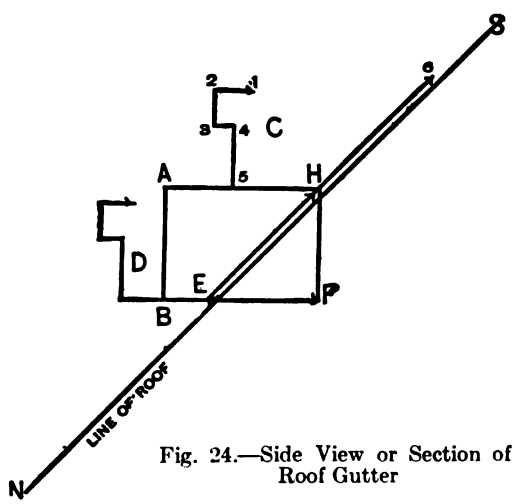

Fig. 24.—Side View or Section of Roof Gutter

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the points J and E. Now take the pitch of the gutter, as shown by A B or H F, Fig. 24, and transfer this hight from the point J on the line B C, Fig. 25, as shown by J F, and draw a line from F to E. Then F E will represent the line of the gutter in the true elevation on the point 6 in the profile A in plan view. Now place a duplicate of the profile or section C, Fig. 24, or profile A in plan view, Fig. 25, as shown by A′ in true elevation, the small figures 1′, 2′, 3′, etc., of profile A′, corresponding to the small figures shown in plan view. Through the small figures 1′, 2′, 3′, etc., in profile A′ in true elevation draw lines parallel to the line F E, which intersect with lines of corresponding numbers drawn at right

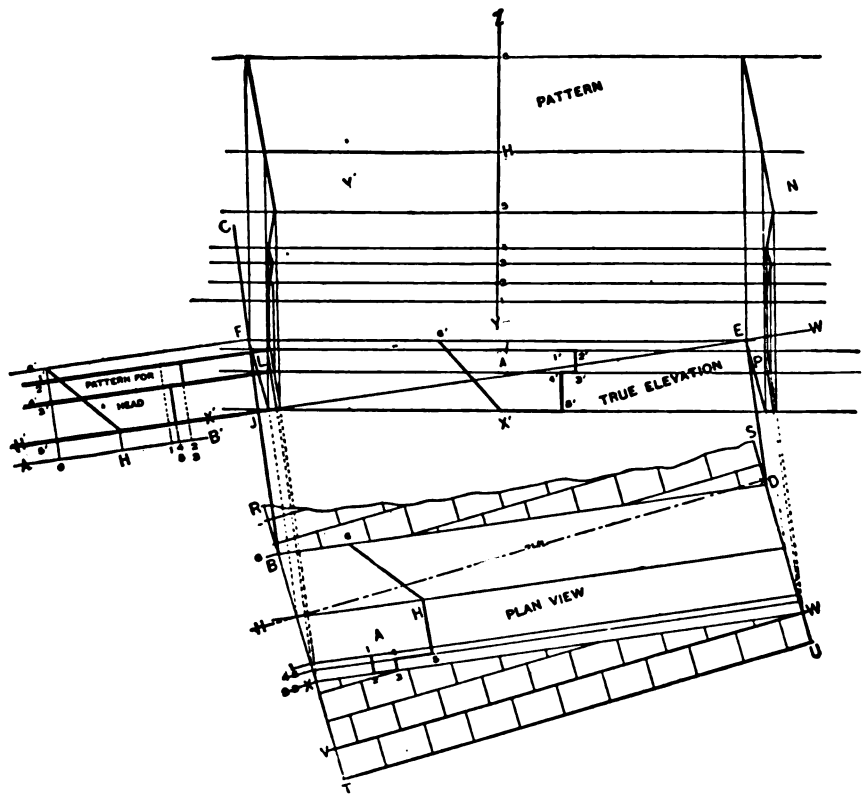

Fig. 25.—Plan View, True Elevation and Pattern of Roof Gutter

angles to the line X W from the intersections made on the lines R T and S U, all as shown. A line traced through these intersections, as shown by L and P, will show the true elevation and miter lines of roof gutter.

To obtain the pattern, proceed as follows: At right angles to the line F E lay off the stretchout of the profile A′, Fig. 25, as shown by the small figures from Y to Z. At right angles to Y Z, or parallel to F E, draw lines indefinitely through

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the small figures in the stretchout, as shown, which intersect with lines drawn at right angles to the line F E from the intersections on the miter lines L and P of corresponding numbers. A line traced through the intersections thus made will be the required pattern.

To obtain the pattern for the head of the gutter shown at R and S, Fig. 22, proceed as follows: At right angles to the line B C, Fig. 25, draw lines from the intersections on the miter line L. It will be noticed that these lines are numbered 5′, H′, 3′, 4′, 2′, 1′ and 6′, corresponding to the same numbered lines, drawn through the profile A′, in the true elevation. At right angles to where the gutter intersects the line X B, plan view, Fig. 25, draw short lines, as shown by 2, 3, 4, 5, 1, H and 6, corresponding to the same numbered lines drawn through the profile A in plan view. Now parallel to the lines drawn at right angles to B C draw a line, as shown by A′, B′, upon which place the widths, as shown by 2, 3, 4, 5, 1, H and 6, corresponding to the intersections on the line X B, plan view, as shown by 2, 4, 5, 1, H and 6. Then at right angles to A′ B′ draw lines upward from the small figures, as shown, intersecting lines of corresponding numbers drawn from the miter line L, at right angles to B C. A line traced through these intersections will be the pattern for the head of the gutter required at R and S, Fig. 22.

To avoid any misunderstanding, it is well to remark that the sections shown at C and D, Fig. 24, do not represent the true sections on the lines R T and S U, plan view, Fig. 25, and are only drawn to form basis from which to obtain the measurements of the pitch and projection of the gutter, and are sections of the gutter at right angles to B D, plan view, and sections at right angles to F E, true elevation. The pattern for the head of the gutter, as shown in Fig. 25, is the true section of the gutter on the line R T and S U, in plan view.

In practice it would be impossible to lay out a drawing of 21 feet on the ordinary drawing board, although the gutter could be laid out on the floor. To avoid this and to make use of the drawing board, the entire measurements could be divided into eight parts or less, according to the length of the drawing board in use.

The following explanation is given to illustrate what is meant by dividing the measurements: By dividing the measurements into eight parts, instead of laying off 21 feet, as shown from V to W, Fig. 25, take one-eighth of same, which is 2 feet 7½ inches, and make V W equal to 2 feet 7½ inches; then, instead of making V X, Fig. 25, the projection of gutter, as shown from E to F, Fig. 25, make it one-eighth of E F. And having obtained the line X′ W′ in true elevation, Fig. 25, instead of making J F equal in hight to A B or H F, Fig. 24, make it

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one-eighth of the distance. By dividing the length, projection and pitch of the gutter each into the same number of equal parts, the same angles are obtained as in the full size drawing.

It is also proper to remark in this connection that, if but one gutter was being put up, it would hardly pay to get out the patterns as above described, as the time involved in obtaining the patterns would cost almost as much as the amount a small gutter would bring. In such a case the gutter would be made a few inches longer than the desired length and placed on the roof in its proper position, and tacked with a few roofing nails. Then take a carpenter's square and place the long arm on the roof parallel with the eave line, and, holding the short arm of the square perpendicular, mark off a perpendicular line on the top and bottom ends of the gutter where required, and trim with the hand shears or snips. Then the lower cut will represent the miter line on which the second piece of gutter would be joined, and the top cut may be used to obtain the pattern for the flat head, by simply holding a piece of galvanized iron or other metal against same and marking off the shape.

It is, however, a good plan to obtain accurate patterns, as described, which are saved for future use; and when a gutter of this style is required, it can be given the same shape and pitch. Thus the same pattern can be always used, it only being necessary to obtain the amount of pitch required on every gutter of a different length, so that a chalk line indicating the pitch can be struck on the roof on which the bottom line of the gutter is placed.

Now, as above described, if a gutter of 21 feet has 4 inches pitch, then a gutter of 10 feet 6 inches would have but 2 inches pitch, or in other words, the gutter would have a fall of 4-21 inch to the foot. As 4-21 makes the figuring complicated, $\frac{1}{4}$ inch fall to the foot could be given and the patterns cut accordingly. This would make the pitch on 21 feet equal to $5\frac{1}{4}$ inches. In case a gutter was required measuring 21 feet $5\frac{1}{2}$ inches, it would be necessary to obtain the amount of pitch required for the $5\frac{1}{2}$ inches in length. To obtain this without tedious figuring, construct on a piece of heavy white cardboard, for future reference, a triangle whose base is 12 inches in length (divided into half and quarter inches) and the altitude or perpendicular hight as much as the fall of the gutter is to the foot, which in this case is $\frac{1}{4}$ inch. Connect the altitude and the base by a line called the hypotenuse or slant line, which completes the triangle. From the divisions on the base of the triangle draw lines at right angles, intersecting the hypotenuse, or slant line. Then place one leg of the dividers on the $5\frac{1}{2}$ inch division on the

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base, and the other leg of the dividers at the point where the 5½ inch perpendicular line intersects the hypotenuse; then the distance between the points of the dividers will be the amount of pitch required for the 5½ inches of gutter. This rule applies to any measurements whatever.

LAYING OUT THE PITCH OF GUTTERS

For example, take a hanging gutter or eave trough, 24 feet 6 inches long, the water to run from left to right standing in front of the gutter and the wire bead to be on the outside, the pitch to be 3½ inches on the length, or, in other words, the pitch to be 3½ inches on A to B, Fig. 26. Two flat heads will be required, which can be pricked from the section shown by C A D for the high-point of the gutter and B A D C for the lowest point, allowing for the wire on C A, for the small head and C B for the large head.

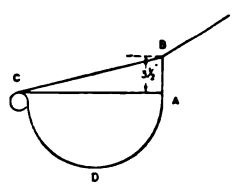

Fig. 26.—Laying Out the Pitch of Gutters

Strike a chalk line on the floor as shown by A B, Fig. 27, assuming that 7 feet sheets are used, then for 24 feet 6 inches, there are required three sheets 7 feet long and one piece 3 feet 9 inches, allowing 3 inches for laps as shown by dotted lines C D and E of Fig. 27. We

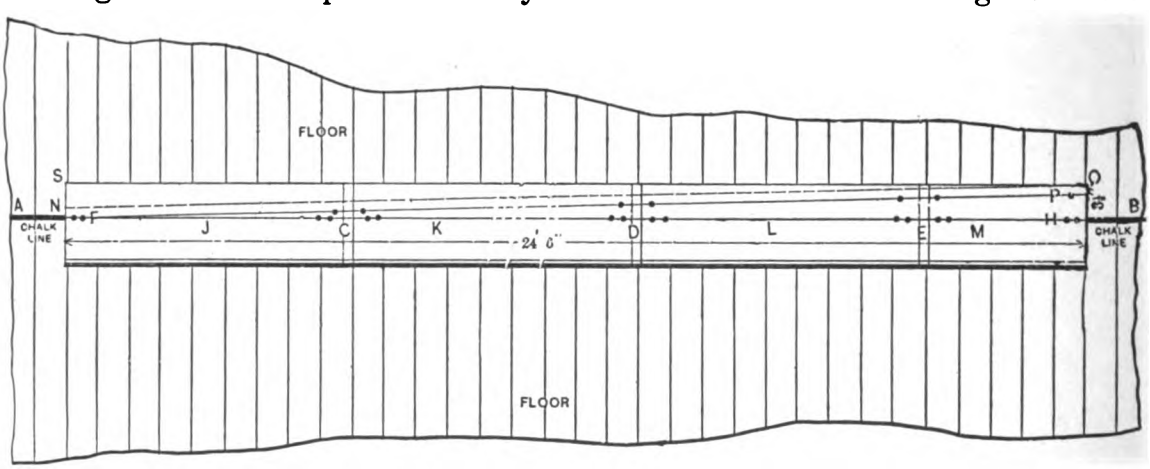

Fig. 27.—Method of Laying Out Gutter on the Floor to Obtain Pitch

now bead the three sheets and the one piece. Next get the stretchout of C D A, Fig. 26, place upon and lay it off across the beaded sheets, marking at each end of the sheet the double dots, as shown on the line F H, Fig. 27. Draw a line through each sheet on the double dots. As the water is to run to the right, we start on the right side with the piece M, placing the line drawn through the double

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dots upon the chalk line A B, Fig. 27. Then take the sheet L, and giving 1 inch lap, as shown at E, place the line drawn through the double dots upon the line on the piece M to the right, and on the chalk line to the left, performing the same operation with the sheets K and J. As the double dots shown at F, Fig. 27, represent the high part of gutter, the next step is to measure 3½ inches from the double dots H, Fig. 27, as shown at P. Then strike a chalk line from P to F, as shown, and which will be the line on which to make the bend. If a straight line is desired on roof, strike a line as shown by N O, Fig. 27, parallel to the line P F. The portion at S O to be cut away. In striking the pitch, as shown in Fig. 27, the bead should be laid downward.

MOLDED GUTTER ON BRICK WALL

Fig. 28 shows the method of fastening a sheet metal molding to a brick wall, on which the gutter is formed of wood and then lined with sheet metal. A is a section of the brick wall, the upper portion, L, being built up to but half the thickness of the wall, as shown, thus leaving a space on which to build the gutter, as shown at K. C represents the wooden wall plate, fastened to the wall by means of the bolt B, which has an angle at the bottom. The bolt is placed upon the wall when up as high as shown by the dotted line X. The wall is then built up around the bolt, after which a hole is made in

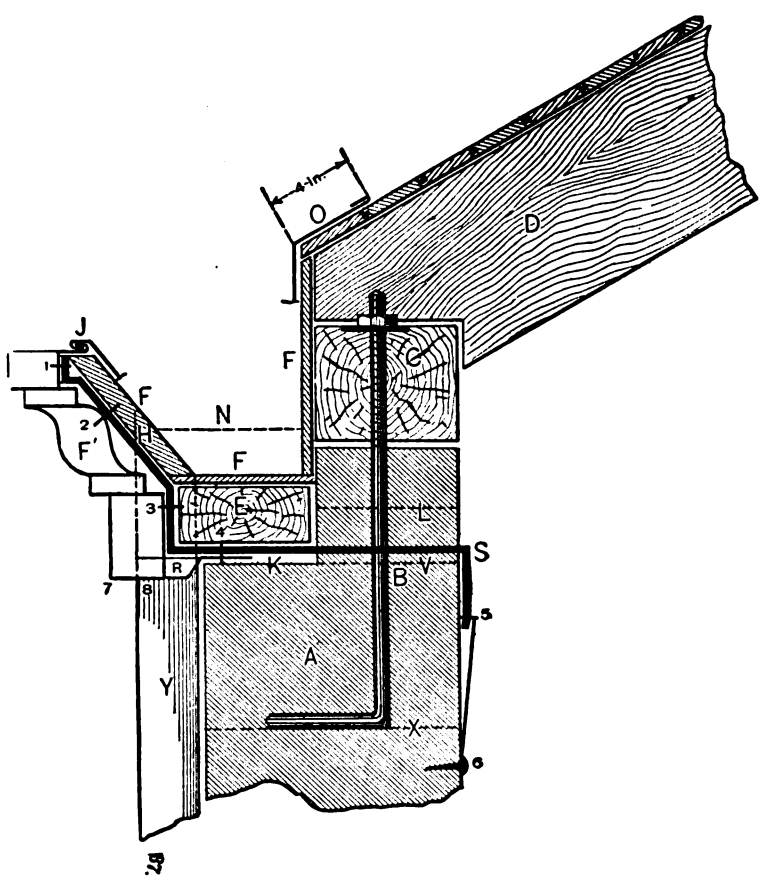

Fig. 28.—Fastening a Sheet Metal Molding to Brick Wall

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the wall plate C and set over the bolt and fastened with a washer and nut, as shown. D represents the rafter on which the roof is planked, and to this the flange of the gutter lining is nailed. As all this has no bearing on the cornice work, it is only briefly explained so the reader may better understand the sectional views of this kind of work. In making the details for the molding and brace, shown in Fig. 28, care should be taken that the inside brace, shown from 1 to 5, is so drawn that a portion will meet the top member of molding at 1, at part of the ogee, as shown at 2, at the flat portion, shown at 3, and on the flange of the drip, shown at 4. Bolts are then inserted through the molding and brace, as shown at 1, 2, 3, and 4. The thickness of the wall A is taken and the brace made to extend through it, allowing for a flange to bend down behind the wall, as shown at 5. The length of the flange should be less than the hight of a brick. Care should be taken in drawing the top flange and lock of the molding that the lock J, Fig. 28, comes directly over the center of the gutter plank H, so that when the sheet metal lock of the gutter lining is locked into J of the molding and pounded down with the mallet the blow will come directly over the center of the wooden plank H. If the lock J should come in further than the thickness of the gutter plank H, a bad seam would be the result, because the locks could not be driven together, there being no foundation to pound on. It will be noticed that that portion of brace in Fig. 28 which meets the ogee at 2 at once gives the shape of the gutter on the inside, against which the plank H is laid, as shown.

After the molding is formed on the brake, and set together to the required length, the braces are inserted about 30 to 36 inches from centers, care being taken that the length of the brace from R to S, in Fig. 28, is correct so as to slip over the wall.

The mason, when building up the wall, usually has a scaffold on the front, which is often used by the cornice maker to put up his work. One way to set moldings of this kind is to have the mason stop with his wall when he gets up as far as shown by the dotted line V, Fig. 28. The braces are put in the moldings in the shop, with the flange S 5 already bent. A hole is punched through the brace, as shown at 5, in which to fasten the wire.

Now set the molding and braces upon the wall and have the drip R of the molding fit well against the face of the wall, as shown. As the molding will have a tendency to tip forward when set, fasten a piece of wire in the hole 5 of brace, press down the brace at S firmly onto the wall, and fasten the wire with an anchor nail into the joint of brick work shown at 6. The wall L is now built on top of

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the braces, which holds the molding in its proper position. As the full depth of the gutter down to the wall K is not required, blockings of wood are placed upon the braces. as shown at E, Fig. 28. In gutters of this kind the carpenters should prepare the pitch of the gutter. F represents the lowest point of gutter and N the highest; and after obtaining the required length of the gutter the lowest point would be blocked up with wood to the hight of F and the highest point blocked with wood as high as N. A chalk line is then stretched from N to F and intermediate blockings placed. The gutter is planked out as shown by F F F and connected with the roof boards, after which it can be lined with either tin, copper or galvanized iron, locking the lining into the front lock on molding as before explained, and leaving a flange on roof of about 4 inches, as shown at O, which would be sufficient lap, whether the roof were covered with tin, slate or shingles.

It is the writer's preference in putting up moldings of this kind to let the mason and framer first finish their work complete. When the work is put up before, by the time the mason has finished his wall and the framer has his wall plate and rafters set the molding is usually pressed out of shape and flattened.

When putting up the molding after the wall is finished, set it temporarily against the wall and mark where the braces will come, so as to cut the holes shown from L to V, Fig. 28. As before explained, the angle of brace S 5 should be less than the hight of a brick, so that the holes cut with the use of a chisel and heavy hammer through the brick wall need be the hight of one brick only. The braces having been slipped through are then drawn down with wire, as before explained, and the mason closes up the holes with brick, thus holding the braces firmly in position. Y in Fig. 28 represents the leader to carry the water from the gutter. The back of the leader, lying against the wall, is carried up through the blockings, as shown by the dotted line, and intersects the gutter on the bottom line F. The front of the leader is run up through the molding and intersects the plank H at F. Now, if the

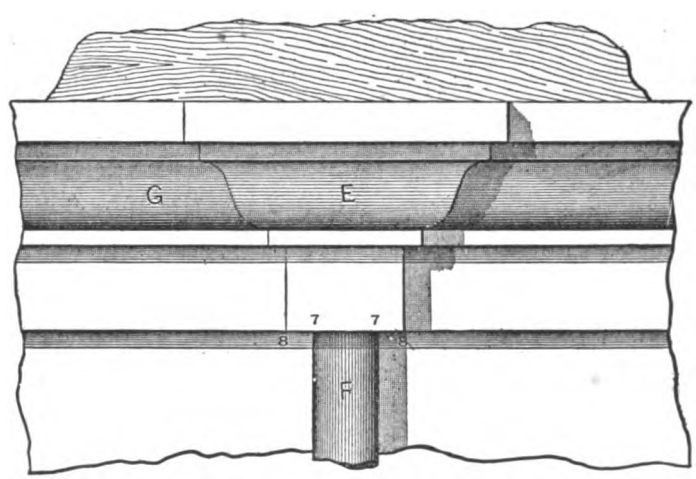

Fig. 29.—Front Elevation of Molding, Leader and Head

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leader was left in this position it would deface the entire front of the molding; so to overcome this a projection the width of the leader is placed over it, as shown at F′, Fig. 28. This at once forms a leader or conductor head, the face of which is shown at E, Fig. 29. The projection 7 8 and 7 8, on either side of the leader F, Fig. 29, is the same as the projection 7 8 over the leader Y, Fig. 28.

Fig. 29 also shows a portion of front elevation of the molding G, which miters to the leader head E, as shown.

Fig. 30 is a part of Fig. 28 reversed, showing top brace fastened at top and bottom to prevent the gutter from breaking down when filled with snow and ice.

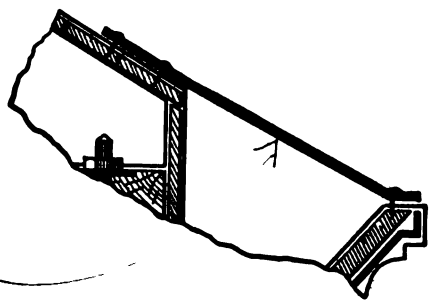

Fig. 30.—Part Section of Gutter, Showing Top Brace

After the gutter is lined and the top lock is soldered watertight a galvanized iron brace is screwed to the roof boards and into the plank to the front of the gutter, as shown. These braces are placed about 30 to 36 inches apart, and are made of 3-16 × 1 inch band iron, the same material being used for the inside braces, shown in Fig. 28.

Having now explained how the work is to be constructed and put up, we are in a better position to take the measurements and obtain the patterns.

Fig. 31 is a rough sketch of the roof plan of a bay window, showing the leader, projection of the leader head and angles of walls. The measurement for the moldings would be taken upon the wall line from A to B, B to C and C to D,

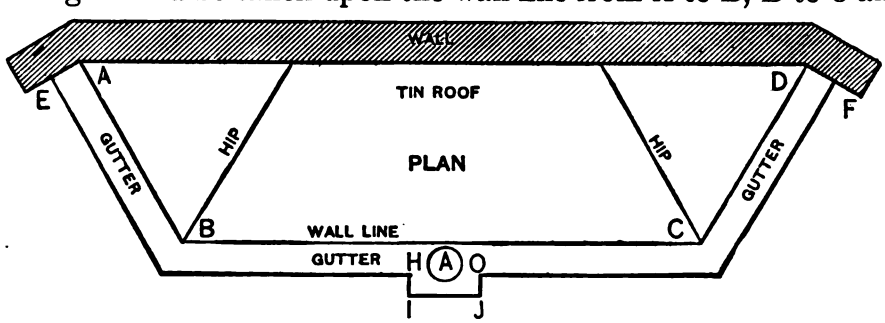

Fig. 31.—Roof Plan of a Bay Window.

the angles A B C and B C D being the same. The angle is taken with a bevel, as explained in a previous article. The angles at A E and D F are square. Two miter patterns would be required, one for the angle A B C or B C D and the other for the leader head shown in Figs. 47 and 48.

To obtain the two patterns for the miters proceed as follows: Let A^2, Fig. 32, represent the section or profile of the gutter, shown at F′, Fig. 28. Place the profile

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in its correct position, as indicated, having the line 12 13 of the profile A^2 perpendicular, and divide the profile into a number of parts, as shown. In line with 2 3 of the profile A^2 place the angle of the leader head, as shown by H I J or

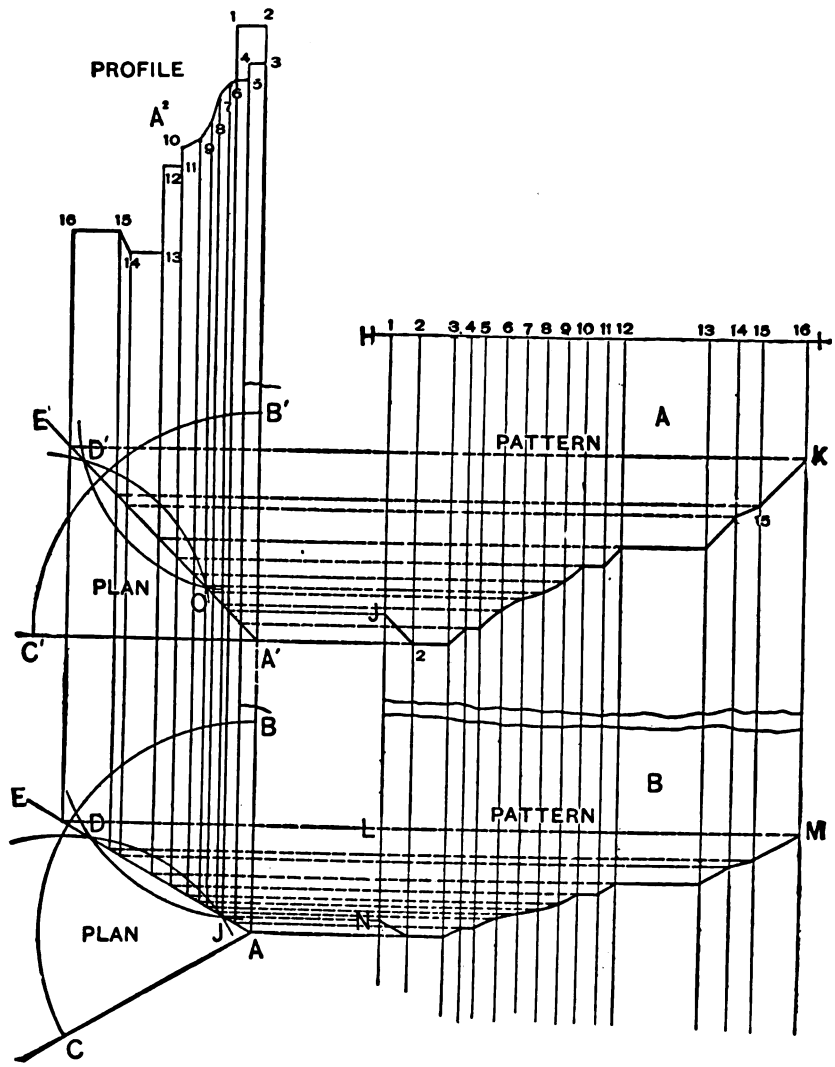

Fig. 32.—Method of Obtaining Two Miter Patterns, Using One Profile

I J O in Fig. 31, which is a right angle, as shown by B′ A′ C′ in Fig. 32. Then again in line with 2 3 of the profile A^2, Fig. 32, place the angle of the wall A B C or B C D of Fig. 31, as shown by B A C in Fig. 32.

The next step is to obtain the miter lines of these two angles, for which proceed as follows: Place one leg of the compass at the point A′, Fig. 32, and strike an arc, as shown, from C′ to B′. Now, with C′ and B′ as centers strike the two

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arcs, as shown intersecting each other at D′ and O. A line drawn through these two intersections will be the required miter line, as shown from E′ to A′.

The same method is employed for obtaining the miter line for the other angle. With A as center strike the arc from C to B; then with C and B as centers strike the two arcs shown intersecting each other at D and J. A line drawn through D and J will be the required miter line, as shown from E to A, Fig. 32. When miters for different angles are required, and the profile is the same, it is well to use this method of placing the miter lines under one another, thereby saving considerable time in spacing the profile for each miter line.

From the divisions on the profile A^2 drop perpendicular lines, as shown, cutting the miter lines E′ A′ and E A. At right angles to the perpendicular lines draw the line H I indefinitely, upon which place the stretchout of the profile A^2, as shown by the small figures 1, 2, 3, 4, etc. At right angles to the stretchout line H I draw lines indefinitely from the small figures, which intersect with lines of corresponding numbers drawn from the intersections on the miter lines E′ A′ and E A parallel to the line H I. Draw lines through these intersections; then H I K J will be the miter pattern for the angle required for the leader head shown at E, Fig. 29; and L M N the miter pattern for the angle taken on the wall line A B C or B C D, Fig. 31. It will be noticed that the angle B′ A′ C′, Fig. 32, is a right angle, and that the pattern obtained is for a square return miter. The method here shown is the long rule for obtaining square miter patterns, and it is the writer's preference always to use the short method; but when cases arise where miter patterns are required at other than right angles, and a plan must be drawn as B A C in Fig. 32, then we can just as well draw the plan of the right angle B′ A′ C′, as but one operation is required to intersect any number of miter lines.

Fig. 33 shows the method of cutting the full size patterns from a sheet of iron with as little waste as possible. Let A B C D represent a sheet of iron, upon which the patterns for the leader head are to be laid out.

In practice, the front edge of the sheet at B would be cut straight, so that the lock would show an even edge when bent at the brake, and to which the lock of the gutter lining would be attached, as at J, Fig. 28. A stretchout of the profile A^2, Fig. 32, is now taken upon a strip of zinc about ⅜ inch wide, upon which the bends of the moldings are dotted off. These dots are now transferred upon the sheet by placing the zinc stretchout even on the line A D, Fig. 33, and dotting off the sheet by means of a scribe awl and hammer. Horizontal lines are then drawn through these dots, which represent the bends of the molding. Next turn the

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pattern A of Fig. 32, and place the line 2 2 of pattern to correspond with the line 2 2 upon the sheet of iron in Fig. 33, and mark the miter, as shown, from H to I, with a scribe awl. Take the width of the leader Y, Fig. 28, and place it as shown

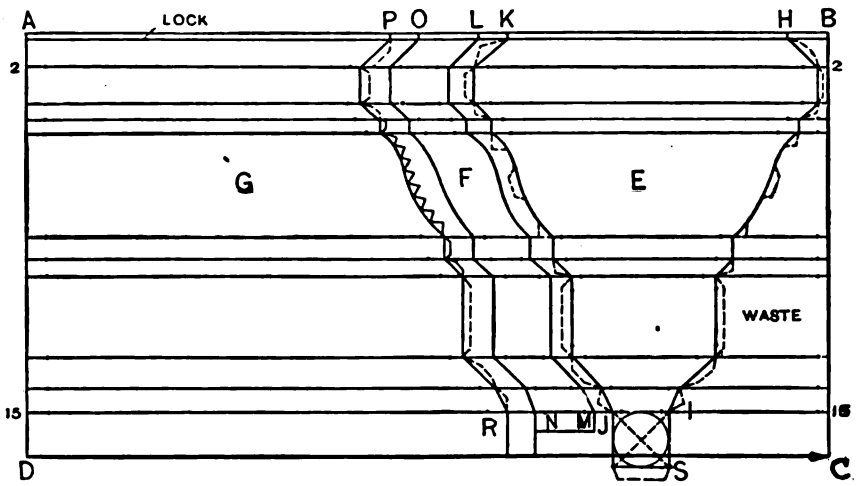

Fig. 33.—Method of Cutting Full Size Pattern

from I to J on the line 15 15, Fig. 33; then, reversing the pattern A of Fig. 32, lay the point 15 of the miter upon the point J on the line 15 15, Fig. 33, and having the line 2 2 of the pattern upon the line 2 2 of the sheet of iron, mark the miter, as shown, from K to J. Then will K H I J or E of Fig. 33 represent the pattern of the face of the leader head shown at E, Fig. 29. As the bottom of the leader head is to be placed on the face E, Fig. 33, and the sheet of iron not being wide enough, a small piece of iron would be soldered on. At right angles to I J draw I S, equal in length to I J, and make a square, as shown. Draw the dotted diagonal lines, the intersection giving the center point from which to strike the circle corresponding to the diameter of the leader Y, Fig. 28, and which would be cut out with a circular shears or snips. This completes the pattern for the entire face and bottom of the leader head, laps being allowed, as shown by the dotted lines.

Where the leader head intersects the moldings, as at H and O, Fig. 31, it is called an inside miter. Therefore the pattern A of Fig. 32 would be placed in such a position on the sheet of iron shown in Fig. 33 that L M would represent a reverse cut, or inside miter. As M N of Fig. 33 would be joined to I S, take the width of I S and place it as shown by M N and L O, and mark the miter cut. Then will L M N O or F of Fig. 33 represent the projection of the leader head, shown at F′, Fig. 28, and the miter cut O N of Fig. 33 be connected to the face E on the cuts J K of H I. Now take the pattern A of Fig. 32, and place 2 2 of the pattern

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upon the line 2 2 of the sheet of iron and mark a reverse or inside miter, as shown by P R, Fig. 33. Allow laps, as shown by the dotted lines from P to R; then will A P R D or G represent a portion of the molding G, Fig. 29, on which the leader head would be joined, the cut L M on Fig. 33 being joined to P R of the same illustration. The measurement on the molding would be made upon the line R 15 of Fig. 33, that being the bend which sets upon the brick wall. Whatever more molding would be required to obtain the desired length would be joined to the piece, G, Fig. 33, having the miter cut the same as B, Fig. 32, for the angles A B C or B C D, Fig. 31.

ANOTHER MOLDED GUTTER ON BRICK WALL

Fig. 34 is another form of molded gutter for brick wall, showing the method of fastening it to the wooden wall plate B. A represents the brick wall, B the wall

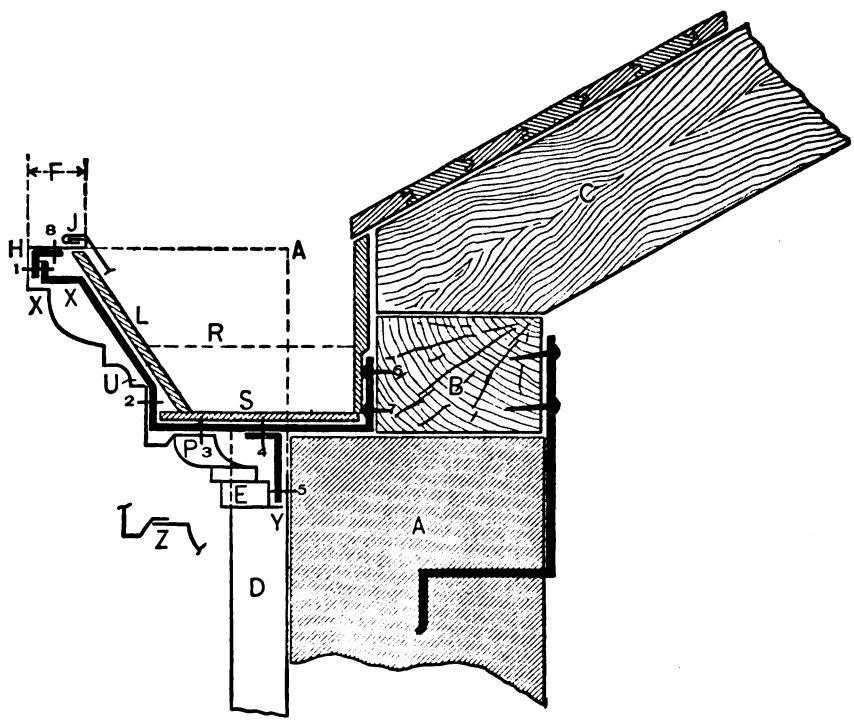

Fig. 34.—Fastening Sheet Metal Molding Against Wooden Plate

plate, and C the rafter upon which the roof boards are fastened. It will be noticed that part of the molding, from P to E, drops down over the wall, and that the top bend of the molding has an angle iron inserted at H.

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After the detail of the molding is made, draw a section of the angle iron in the top edge, as at H, also marking the position of the bolts through angle iron, shown at 1 and 8. Now draw the top flange and lock of the molding, making the top flange as wide as shown at F, so that the bolt 8 passing through the angle iron will have plenty of play room to pass the lock J; or, in other words, the lock J should be placed at such a distance from the bolt 8 that the gutter lining can be locked into the lock J, without interfering with the bolt. When making the detail of the inside brace, care should be taken that it meets the angle iron at 1, and the length of the brace at X X should be such that when the plank L is laid upon the portion of the brace from X to U it will come directly under the lock J; in this way, when the gutter lining is locked into the molding the seam can be pounded down tight. The other portion of the brace should meet the molding, as shown at 2 and 3, then back to the wall plate with an angle bent upward and nailed to the wooden plate at 6 and 7. The small angle at 4 and 5 is intended to keep the drip molding tight against the wall, without nailing or defacing the molding. The angle should be fastened to the main brace by means of a bolt, 4, and then bolted through the flange of galvanized iron at 5. The hole 5 should be countersunk, so that a smooth surface is obtained. Care should be taken in bolting the angle 4 5 to the main brace that one is exactly like the other, otherwise the drip molding will not lie even against the wall. The length of the stove bolt which is inserted into the hole 5 should not be greater than the inside width of the member Y of the drip molding.

After the molding is formed and set together to the required length the angle iron is held in position with hand vises, as explained in a previous article, until the top bolts are all inserted from the bottom up, as shown at 2, Fig. 35. After the top bolts are all in place and the nuts fastened the front bolt 1 is placed through the molding, angle iron and brace and fastened on the inside; the bolts are also inserted at 2 and 3, Fig. 34, and the angle bolted to the main brace at 4, being careful to have the distance from the angle 4 5 to the angle 6 7 the same as the distance from the front of the wall to the wall plate B. The angle irons and braces can all be put in the molding in the shop. Let us suppose the molding is 28 feet in length, in which there are ten braces. In hoisting up on the wall two ropes would be required, looping and fastening each rope on each side to the third brace from the end and tying around the brace X, Fig. 34. When the molding is up set it on the wall, and drive two anchor nails into the wall plate B at 6 and 7, thus drawing the drip Y tight against the wall. The gutter is now lined with wood by

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the carpenter, S being the lowest point and R the highest point, it being blocked up with wood, as explained in a previous article. The gutter is then lined with either tin, copper or galvanized iron and locked into the lock of the molding at J, Fig. 34. In Fig. 35 is shown a part of Fig. 34 reversed, with the top brace bolted to the angle iron and screwed to the roof board. At 1 is shown the bolt, passing from the outside through the molding, angle iron and brace and fastened on the inside. In putting on the top brace, shown in Fig. 35, care must be taken when loosening the nut of the bolt 2 that the bolt does not fall inside of the molding. To prevent this lay a strip of wood onto the part of brace X X, Fig. 34, before the gutter is planked, to uphold the bolt 8 when the nut is loosened.

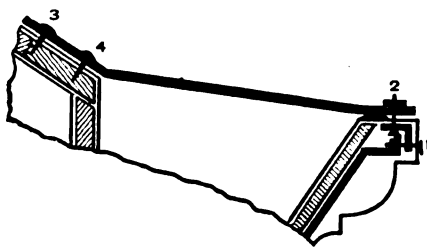

Fig. 35.—Part of Gutter with Top Brace

After the top brace is bolted at 2, Fig. 35, screw to the roof planks, as shown by 3 and 4. This top brace will keep the gutter from bending down from the weight of the snow and ice. In milder climates, where the snow is not considered, the top braces could be omitted.

Let D, Fig. 34, represent a square leader, meeting the lowest point of the gutter S, as shown by the dotted lines. To make a neat finish where the leader

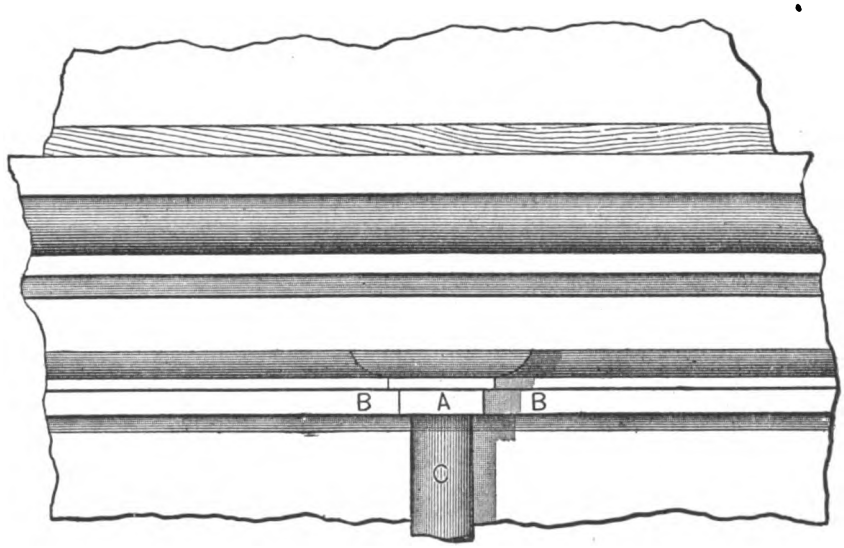

Fig. 36.—Front Elevation of Molding, Leader and Head

D cuts through the drip molding, a small head is made for the leader, having the same projection as the leader D, as shown by P E. Fig. 36 is a portion of the

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front view of molding, leader and leader head, the section of which is shown in Fig. 34. B B represents part of the drip molding, A the leader head and C the leader.

Having now explained the method of construction, as shown by the front and sectional views, we will proceed to take the measurements and obtain the patterns.

Let A B C D, Fig. 37, represent the plan view of a tin roof, showing the brick walls and the molding on the front from A to B. O represents the section of a square leader, shown in Fig. 34 at D, and in Fig. 36 at C. When measuring the length of the molding, measure upon the wall line from 1 to 2, Fig. 37. As no

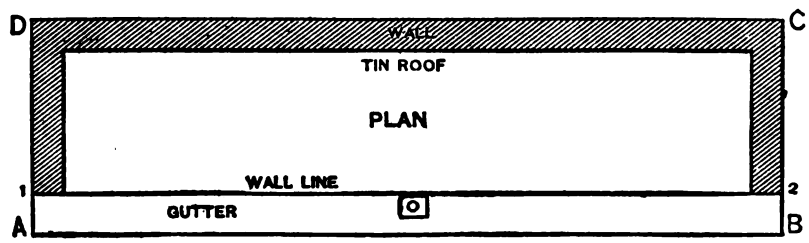

Fig. 37.—Roof Plan, Showing Leader and Gutter

return miters are required in the molding, two flat heads, shown at A and B, Fig. 37, are placed on each end of the molding. As the water is to run to the center of the building, the leader will be placed at O, Fig. 37, with a projecting leader head to the hight of the drip molding, the face of which is shown in Fig. 36 at A, and the projection in Fig. 34 at P and E.

To obtain the patterns for the flat heads for the moldings, proceed as follows: In line with the wall shown in Fig. 34, draw a dotted line as shown from 5 to A′, and at right angles to it draw a dotted line, H A′, meeting the top bend of the molding H.

Transfer this angle, including the profile of the molding shown in Fig. 34, upon a piece of galvanized iron, by placing the galvanized iron underneath the detail of the molding and pricking through by means of a scribe awl and hammer. The result is shown in Fig. 38 by A B C. In pricking through the profile on detail, it is best first to divide the profile into a number of parts, so as to obtain the stretch-out, and then prick through these divisions.

As the molding usually is made to represent stone after being painted and sanded, and as stone work always shows the bearing upon the wall from the side view, it is well to add 4 inches or more to the pattern of the flat head, as shown from D to E, in Fig. 38.

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Now take the stretchout of the top flange of the molding, shown from H to J in Fig. 34, and transfer it as shown by F and G, Fig. 38, at right angles to A D, and add the lock, as shown from H to I.

At right angles to D A, Fig. 38, draw the line A J. Take the distance of the flange D F in Fig. 38 in the dividers, and placing one leg on the point J strike an

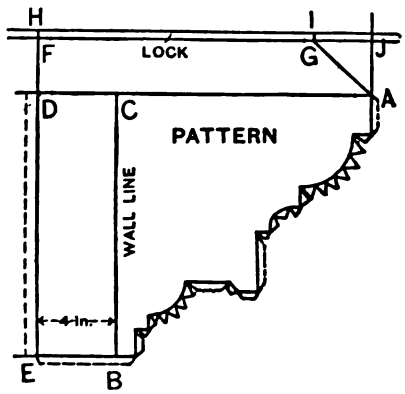

Fig. 38.—Pattern for a Flat Head

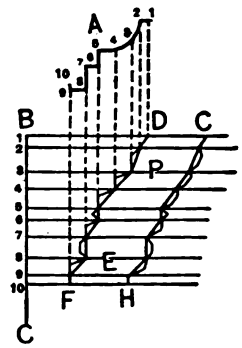

Fig. 39.—Pattern for Return on Leader Head

arc intersecting the line F G at G. Draw a line from A to G, which will be the miter for the top flange of the head, mitering with the top flange of the molding at right angles in plan, shown by 1 A B or A B 2 in Fig. 37. At right angles to F G, Fig. 38, draw G I, which completes the patterns. Allow lugs, as shown.

For the pattern of the leader head proceed as follows: Draw a duplicate of the profile of the drip molding, shown in Fig. 34, at A, Fig. 39. Divide A into a number of parts, as shown. Now draw any perpendicular line, as B C, upon which place the stretchout of the profile A at right angles to the line B C, and from the small figures draw lines indefinitely, as shown. From the divisions obtained in the profile A drop perpendicular lines intersecting the corresponding numbers drawn at right angles to the stretchout B C. A line traced through these intersections from D to F will be the required miter pattern. Now take the distance of the projection of the leader, shown at D, Fig. 34, and with the dividers measure the distance from the miter cut D F, Fig. 39, on the lines 1, 2, 3, 4, etc.; trace a line through the points, as shown, from C to H. Then D F H C, or P and E, will be the pattern required for the projection of the leader head shown by P E, Fig. 34.

In Fig. 40, B A and B represent a sheet of iron, on which part of the bends of the molding have been lined, as shown. Let us suppose that, the length of the molding having been obtained, the leader will come in the position on the sheet shown by J K. Now use the pattern P E, Fig. 39, and place the point F, Fig. 39,

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upon the point K, Fig. 40, placing the line F H of Fig. 39 upon the line K H of Fig. 40, and draw the miter line shown from M to K. Now have J K, Fig. 40, the

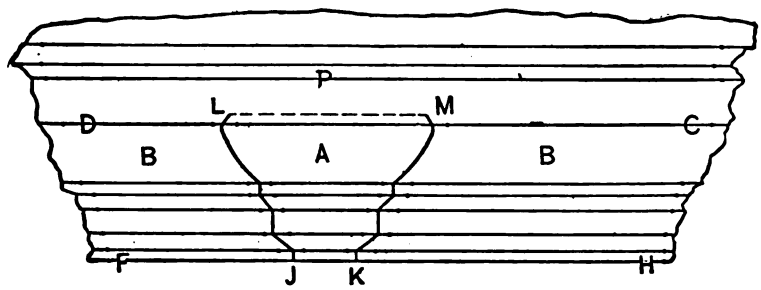

Fig. 40.—Laying off the Miter on the Sheet

width of the face of the leader shown at C, Fig. 36. Reverse the pattern P E of Fig. 39, and place the point F upon the point J, Fig. 40, placing the line F H upon the line J F, and mark the miter line shown from L to J. As the projection of the leader head comes out as far as up to the line R, Fig. 40, when the molding is formed, we can add a small lap, as shown from L to M, to the pattern A of Fig. 40. Now, taking the right handed snips, cut out the pattern, A of Fig. 40, commencing at the point K, on the miter line up to M, over to L and down to J.

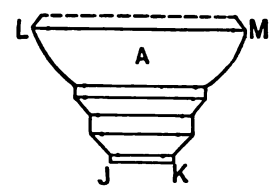

Fig. 41.—Pattern for Face of Leader Head

A in Fig. 41 represents the pattern for the face of the leader head which was so obtained. It will be noticed that the face A of Figs. 40 and 41 has no lap attached, the same being the case with B and B of Fig. 40. For this reason laps have been added to the pattern for the return on leader head, shown at P and E in Fig. 39. The miter cut C H, Fig. 39, is joined to the cuts M K or L J, Fig. 41, and the cut D F, Fig. 39, to the cuts M K or L J, on the sheet B B, Fig. 40, when setting together.

TEN FORMS OF GUTTER CONSTRUCTION

In the following article are shown 10 different forms of gutter construction used under different conditions. The simple forms are those used on frame structures, while the complicated are employed on fireproof construction. In Fig. 42 is shown the simple form used under the eaves of shingle roofs. A is a double beaded gutter fastened to the roof C by means of the hanger B. These hangers can be obtained in wire or strap form or of malleable iron from dealers in tinners' supplies. In Fig. 43 A shows a regular half-round eave gutter, turning on the

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roof at B. When the roof is tile, slate or shingles, the flange B is made 8 inches wide. When the roof is of metal a lock is attached to this flange B as shown at C.

In Fig. 44, is shown another style of gutter, the bottom of which rests on the brick wall and the back of which is flanged to the roof boards with a lock at *b* for

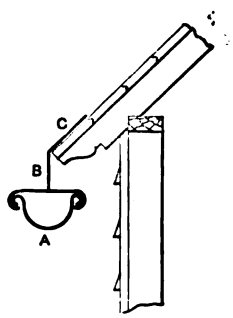

Fig. 42

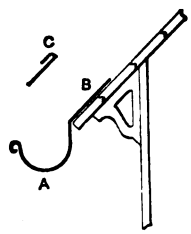

Fig. 43

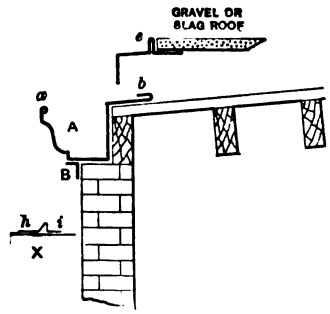

Fig. 44

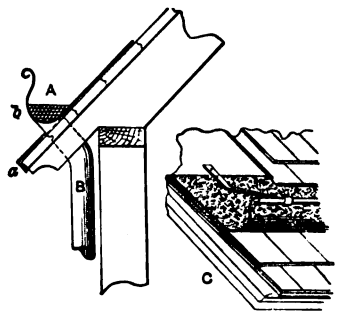

Fig. 45

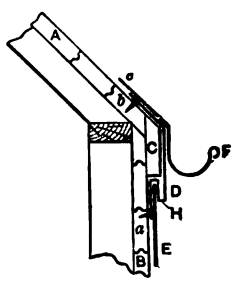

Fig. 46

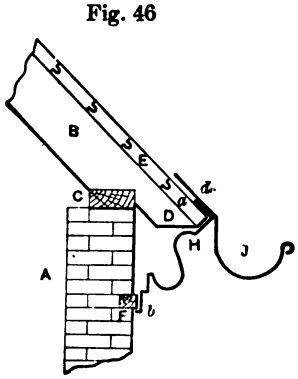

Fig. 47

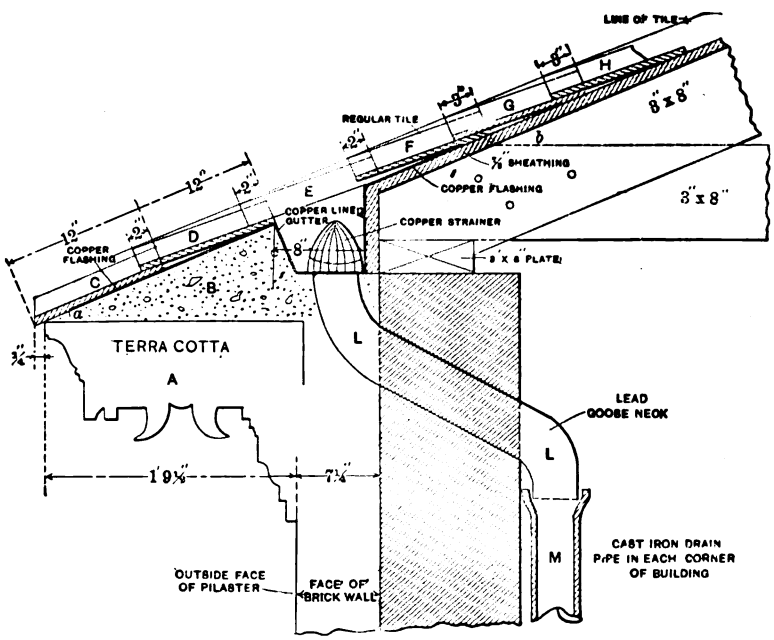

Fig. 48

Different Forms of Gutter Construction

locking purposes. When the roof is of gravel or slag a guard is placed on the gutter flange, bending it direct to the gutter as shown at *e*, or making a V-shaped guard and tacking it with solder to the gutter flange, as indicated at X by *h* and *i*. This

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guard prevents the tar or slag from running into the gutter in hot weather. A wire edge *a* is placed at the top of the gutter, and to this the ordinary braces are fastened. In case the gutter overflows the water has a tendency to follow the face of the mold and run between the gutter and brick wall, thereby causing a leak. This is overcome by soldering an angle B along the entire length of the gutter before it is set; this acts as a drip and leads the overflow over the face of the wall.

In some cases where an eave gutter is objectionable a roof gutter is employed, as shown by A in Fig. 45. If the roof is covered with tin the lower part at the eave *a* is first covered a short distance under the gutter as shown, after which the gutter is set, allowing a lock along a level line to which to lock the flat or standing seam roofing. Should the roof be covered with shingles, slate or tile, the lower part of the eave is first covered, as shown in diagram C; then the gutter is set with the required pitch, the braces fastened and the rest of the roof laid as indicated. Leader connections are usually made as indicated at B with wire mesh bent V shape to act as a strainer over the outlet, as shown at *b*.

When the front or face of a building is covered with corrugated, V-shaped, pressed brick or any other style of metal covering, or when faced with shingle or slate, the rafters running flush with the building line, the finish at the eave is made as follows: After the roof boards A and face sheathing B in Fig. 46 are in position, the required blocking C is nailed in position, and the metal casing D is nailed over the wood blocking at *a* and *b*. A groove is formed as shown, and into this is placed the face covering E, the drip H protecting against leakage in case of an overflow. After the casing D is in a position the gutter F is set in the usual manner, allowing a lock at C if necessary for metal roofing.

Fig. 47 shows another style of construction when the rafter B projects over the brick wall. The rafters are generally set upon the plate C and cut at an angle shown by D at the bottom. The sheathing E is then placed, being careful to have a furring strip or blocking built in with the wall to the required hight, on which to nail the eave mold. This strip is shown by F. Having obtained the proper projection and hight, the molding is nailed to the roof at *a* and to the bottom of the blocking at *b*. Better practice is to use wood screws to fasten at *b*; this prevents the loosening of the lower part of the mold by the nails being drawn out through the action of the weather and sun. When the mold is up the gutter J is set, fastening at *d*, or using band iron hangers and top braces.

Fig. 48 shows a case of fireproof construction when the gutter is hidden below the roof line. The roof is covered with tile in this instance, but the method of

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construction is similar, no matter what the roof covering may be. A shows the terra cotta cornice supported on the wall. The roof rafter rests on the 3 × 8 in. plate, the roof and back of the gutter being sheathed as shown. The top of the cornice is filled with concrete, as shown by B, to continue in line with the sheathed roof as shown. In this concrete the gutter is formed, and the gutter is lined with cold rolled copper down to the eave as far as *a* and on the sheathed roof as far as *b*. In laying this gutter all seams should be first tinned, then locked and sweated with solder, being careful to fasten it with cleats.

The gutter being lined, the tile roof is started by using closed end tile, then the regular tile, allowing 2-inch lap. The gutter is so placed so that the third tile will lap over the top of the gutter, as shown by C, D and E. This third tile E is only placed at the ends of the roof to make a finish when viewed from below, and is omitted otherwise so as to allow the rain water to drain into the gutter. The remainder of the tile are laid in regular order, as shown by F, G and H. The gutter is drained to the inside of the building in each corner, or in recesses built in the wall, to cast iron pipes, as shown by M. At L L is shown a sheet lead goose neck which is run from the gutter J and caulked into the iron pipe M. A copper basket strainer J prevents the outlet from being choked with dirt, leaves, etc.

When a gutter is to be joined to a stone cornice, coping or the like, the work is accomplished as shown in Fig. 49, in which A is the stone or terra cotta cornice and B the roof rafter. At its proper place a groove or raglet is cut into the stone shown by A, or if terra cotta this raglet is molded into the clay before hardening. The wood blocking C and the lining of the gutter F is first completed by the carpenter, after which the molding D is set in position with a lock at E and an edge into the raglet A. On a good job this raglet is filled with molten lead or plugged with lead at intervals and then filled with molten sulphur. Sulphur makes a tight job and need not be caulked like lead, because when the sulphur cools it expands, while the lead contracts on cooling. The molding D being fastened, the gutter lining is now placed in the position shown, locking at E and allowing a lock at G. The lowest point of the gutter is at F and the highest point at H. The leader connection is similar to that shown in Fig. 48.

In Fig. 49 the forward part of the stone or terra cotta cornice is left exposed to the weather, which in some cases is objectionable and is overcome as shown in Fig. 50, in which holes A are drilled into the stone or modeled into the terra cotta about 18 inches apart, 1 inch in diameter and about 1½ inches deep. These holes are plugged with lead, and when the blocking B is completed the molding D is

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set, with a beaded edge at *a*, which acts as a drip. Brass screws are put through the metal D and screwed into the lead plugs A. The screws should not be soldered to the metal, but a concave cap should be set over them and soldered. This makes a tight seam and allows for the expansion and contraction of the metal, as shown at X. The gutter lining is locked into C and the leader connection made in the usual manner.

Fig. 51 shows a rigid form of gutter construction on which the painters' scaffold can be hung if need be. Using this construction there need be no fear

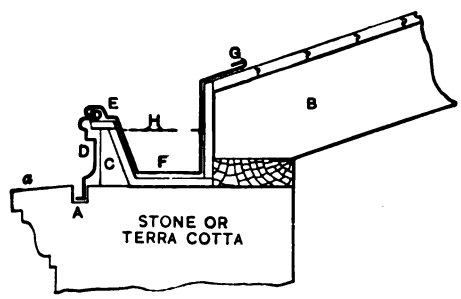

Fig. 49.—Gutter in Stone or Terra Cotta Cornice

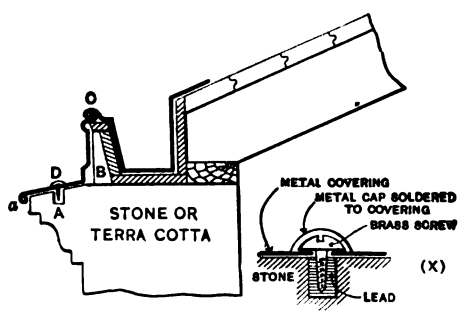

Fig. 50.—Gutter in Stone or Terra Cotta Cornice.

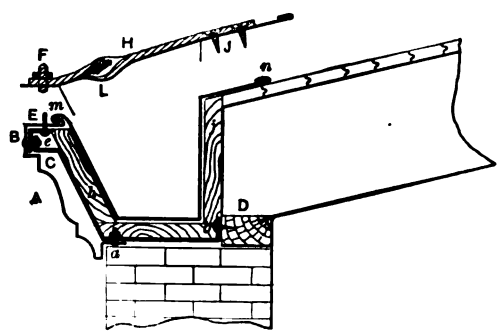

Fig. 51.—A Rigid Form of Gutter Construction

of expansion when the gutter freezes in the winter. It is a construction used on all first-class jobs. After the wall has been built to its proper hight and rafter D put in position the distance is measured from the front edge of the wall *a* to the front of the plate *b* and the necessary brace made. The angle iron B is $1\frac{1}{4} \times 1\frac{1}{4} \times \frac{1}{4}$ inches in size and runs throughout the entire front edge of the cornice. It is bolted to the brace C at *e* and through the top of the cornice at E. A bolt passes through the brace and cornice at the drip *a*.

The cornice A is now set upon the wall and fastened to the wooden plate D at *b*. This draws in the drip snug against the wall. The gutter is then planked as shown by *h j*, it being noted that the lock *m* is so placed that the plank *h* meets

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it to allow the closing of the lock *m* with the mallet when the gutter lining *m n* is locked to it. After the gutter is lined and the lock *m* soldered, top galvanized iron band braces are bolted across the top of the gutter as shown by H. E represents the bolt ready to receive the top brace, which is indicated at F, which shows the nut. The brace is then screwed to the roof as at J. When using band iron braces the tendency of the water when flowing down the roof is to follow the brace and allow small streams of water to flow over the front. This is overcome by putting the twist in the brace as at L. The water is then directed into the gutter and the construction incidently makes the brace more rigid. The bolts for the top braces are placed about 2 inches beside the inner brace C and a metal wedge or strip placed under the head of the top bolt to keep it from falling on the inside after the gutter is lined.

PRACTICAL TALKS ON GUTTERS—I

A cornice recently used on a building provides the subjects for the accompanying illustrations. The design was intended to enhance the effect of the overhung roof, which was supported by braced rafters 3 feet 6 inches apart, a large bracket covering each rafter and its brace; the space between brackets being filled in with a cornice of plain, unmolded metal.

Fig. 52 is a vertical section through the wall and overhung roof, showing sections of the cornice and gutter, a side view of the brackets and a dotted line view of the wood rafters and brace. Fig. 53 is a section on A B; Fig. 54, a section on C D; Fig. 55, a section on E F; Fig. 56, an enlarged view of the adjustable slip lock connection between brackets and cornice; Fig. 57, an enlarged view of lock K, and Fig. 58, an enlarged view of lock J.

It will be seen from the illustrations that the rafters and braces cut the cornice almost completely in two and practically resolve it into a series of short filling-in pieces between the brackets. This suggested the idea of making an adjustable interlocking connection between the brackets and cornice sections. Therefore, the brackets were made with reverse, bent inwardly, projecting grooves or locks on the front, top and back edges, into which the raw edges of the soffit and frieze section of the cornice could be inserted and secured. Section A was formed with lock K to connect with the foot mold E, and lock J to connect with the fascia mold L. The foot mold E and fascia mold L were made in 20-foot sections. The work was then delivered to the building and put up as follows:

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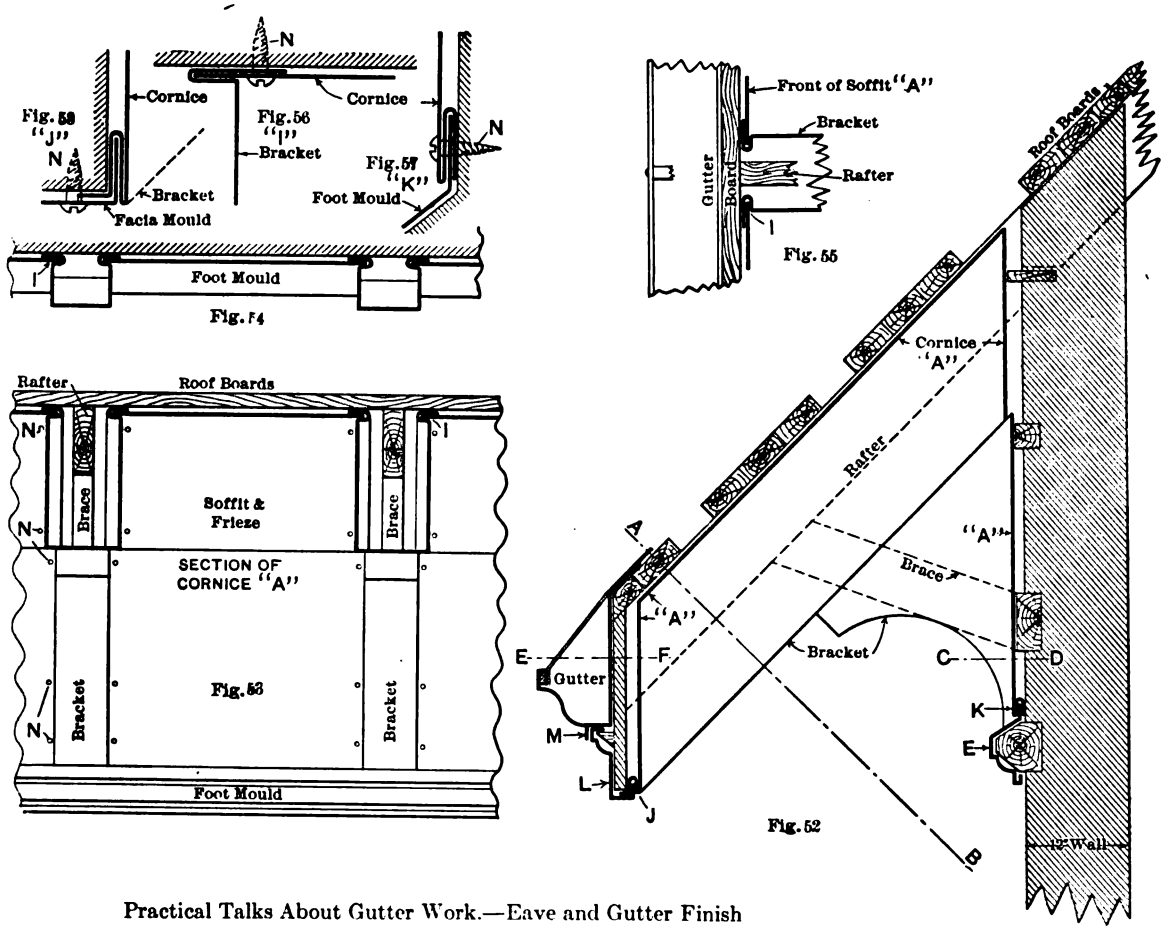
A 20-foot section of foot mold E was first secured in place by screws, and then the first bracket—which, of course, was suitably modified to form an end bracket—was secured in place by nails driven through the groove lock flanges into the wood backing. A section of A was then placed in position by raising it into place alongside of the bracket, springing the vertical back of the same to a curve, so that



Practical Talks About Gutter Work.—Eave and Gutter Finish

lock K could be raised and slipped over the upwardly projecting flange of foot mold E, and then sliding A along against the bracket and into the grooves or locks on the edges of the same, securing by screws, N, which passed through A and the bracket flange and into the wood backing. The next bracket was then placed in position, slide locked to section A and secured thereto and to the wood backing by screws N. Thus a section of A and a bracket were alternately secured in position until the first 20-foot section of foot mold E was covered. Then a 20-foot section of

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fascia mold L was put in place and secured by screws to the wood backing. The bottom edge of the brackets at the point J having the same groove lock as section A at that point, a continuous groove was thus formed to receive the upwardly turned inner edge of fascia mold L. A section of gutter provided with a lead drip M, was then placed in position and secured by ordinary braces, thus completing one section of the cornice. Several roof boards were temporarily left off in order to allow access to the back of the cornice, which made it easy to connect the slide lock joints.

It will be seen that, owing to the adjustability of the slide locks, the work was assembled in place on the building, with the brackets properly spaced, even quicker than it could have been put together in the shop, with the advantage, in the former case, that the work was completed, whereas, in the latter case, it would not only still have been necessary to erect the work after assembling it, but it would have been difficult to get all the brackets spaced to exactly suit the spacing of the rafters.

The principle underlying the construction used in this case, *i. e.*, the use of adjustable lock connections between the brackets and cornice sections, where the cornice is nearly severed by its supporting brackets, could be more largely used than it is. Modifications to suit the conditions in each case will, of course, be necessary; but the principle is good and can be safely recommended.

PRACTICAL TALKS ON GUTTERS—II

Gutters constitute one of the most important branches of the tin and cornice business. They are made in various forms, typical illustrations of which are shown herewith. The form of a gutter changes with the climate in which the building is located, conditions being created in Northern latitudes by low temperatures that never, or, at least, seldom, occur in Southern latitudes. Thus roof drainage is a much simpler problem in warm climates than in cold.

In designing gutters for use in warm climates, there are but three general conditions to meet, viz. That the gutter be large enough, that it be pitched to the outlets and that it be made water tight. Any of the forms shown can be made to meet these requirements, of course; but, in gutters for use in cold climates, the additional requirements occasioned by contraction and the presence of ice and snow must be met. For instance, in draining an ordinary slate roof in New England, it is advisable to use a gutter which, when filled with ice, will not act as

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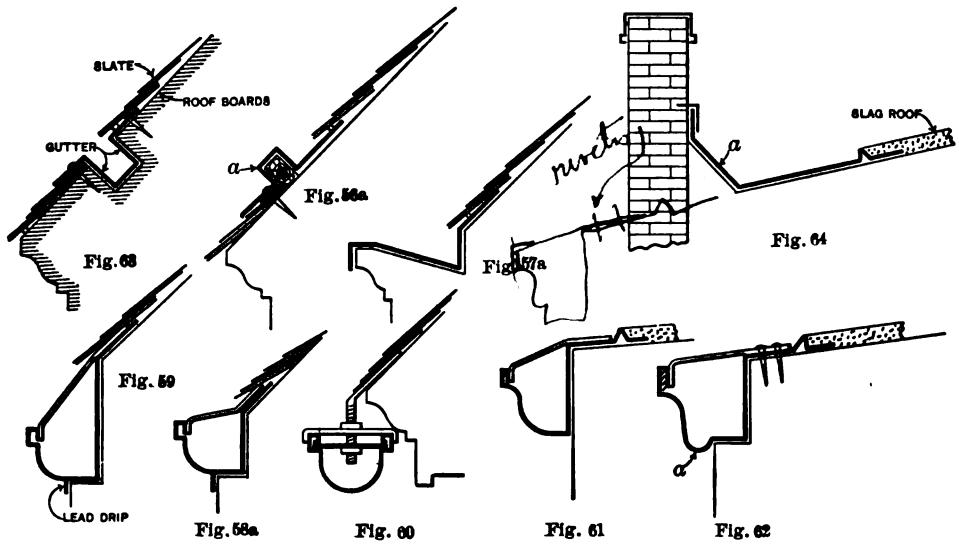
a dam to the water which falls upon or is melted from the ice on the roof, thereby forming a pool which will back up over the slates behind the gutter and flow into the building. Gutters like those shown in Figs. 56a, 57a, and 58a will cause this



General Remarks About Gutters

result, whereas gutters like those shown in Figs. 59, 60, 61, and 62, being placed at the extreme edge and which do not project above the plane of the roof, will not constitute such an obstruction.

Usually gutters are set when the weather is comparatively warm, and, in cold climates, provision should be made for the contraction of the metal, which occurs later. This contraction should be provided for by expansion joints, placed not more than 50 feet apart. The necessity for these joints is another reason why a form of wall gutter should be used, as the joints are most readily made in this form of gutter. The usual manner of constructing these expansion joints will be shown in a later article. The object of the joints is, of course, to afford a flexible point or connection to take up the expansion and contraction in the length of the gutter, thus releasing the seams of strain, and consequently lessening the liability of leaks from broken seams.

In copper gutters, the end lap seams should be tinned before the gutter is formed, and when joining the 8-foot sections together in the shop, after forming, the joints should be riveted, the rivets being placed not more than 2½ inches apart, and the seams then soaked full of good solder, using a clean flux and a large, well heated soldering copper. In joining the 16-foot or 24-foot sections on the building, the joints should be riveted as much as possible and then heavily soldered.

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All wall gutters should be stiffened with galvanized or tinned iron bars, not smaller than 1 × ¼ inch, and twisted dogs, 1 × ⅛ inch, and 30 inches apart, well riveted to the bar and secured to the roof. Such gutters should also be provided with drips, either formed integral with the gutter, as in Fig. 62, or a lead drip securely soldered thereto, as in Fig. 59. The latter method is preferable, for the reason that the bottom of the gutter is left plain and free from bends, and the dip or groove *a*, Fig. 62, incident to the former method, thus being less likely to catch and hold leaves and debris that tend to corrode the metal. Furthermore, the pendant lead drip can be bent or dressed to suit irregularities in masonry work, which cannot be done when the drip is formed integral with the gutter.

Ice is not likely to form and remain in gutters of the types shown by Figs. 63 and 64, for the reason that the entire under surface of the gutter is within the building and therefore exposed to the heat from below, which prevents the adhesion of ice to the gutter, leaving a free passage for the water to the outlets at all times.

PRACTICAL TALKS ON GUTTERS—III

Different methods of getting out and laying or putting up some of the gutters shown in the preceding article are described as follows:

First, take Fig. 63, already mentioned. Assuming the material to be tin or copper, it should be first put together in rolls of proper width, and the seams well locked and soldered, care being taken, if the gutter is of copper, to tin as much of the ends of the sheets as will be taken up by the locks before turning the edges. The carpenter or mason usually leaves a stage in position at the eaves, and as the roof below the gutter should be slated before the gutter is put in, thus necessitating the presence of the slater with his roof stages, the next step is to take the gutter in rolls to the building and form it on the spot, as follows:

Roll the material out on the roof just above and parallel with the gutter, securing it in a perfectly straight line with small nails in the extreme top edge, but partly driven, using the stages above mentioned to operate from. Then take a narrow strip of metal the length of which equals the width of the gutter lining, and form it to the profile of the gutter trough at one end of the same, by pressing it into place in the trough; prick punch the bends. Remove and straighten the strip, lay it on the corresponding end of the gutter lining, and transfer the prick marks from the strip to the lining. Repeat this operation at the other end of

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the stretch. The length of the stretch is governed by the distance between the highest and lowest points in that slope or portion of the gutter. Now, mark the two middle bends by chalk line the full length of the stretch, and make the lower middle bend with the gutter tongs. Tack a few blocks on the roof below the gutter and adjacent to the face just turned up, to prevent the work from sliding down the roof. Then remove the retaining nails in the upper edge, and turn the upper middle bend with the tongs, thus resolving the work into a long U-shaped trough, except that the bottom is flat instead of rounded. Now drop the lining into place in the gutter and hold down with the foot, pressing on a narrow board laid in the bottom of the gutter, and bend the top and bottom laps or aprons over on the roof above and slated roof below, respectively.

Just before turning the apron over on to the slate below the gutter, a brake or angle of about 45 degrees should be turned on the edge of the same with $\frac{1}{2}$-inch gauge roofing tongs, thus insuring that the edge of the metal will lie close to the slate. This apron should be secured by screws passing through the slate, or, what is better, a narrow board about the thickness of the slate roofing should be laid on the roof flush with the lower edge of the gutter trough, against the lower edge of which the slate ends, thus forming a protection for the slate, as well as means of securing the metal apron. The upper apron is simply nailed along its edges to the roof boards, and finally covered by the slates or shingles.

Another method is to form all the bends in the brake in 8 or 10 foot lengths, and deliver the work to the building in sections. This is a much quicker method, provided the carpenter work of the gutter is straight and accurate, but such a carpenter job on gutter troughs is seldom met with.

The advantages of the first method are, rounded bends that do not crack or strain the metal, close fitting of the lining to the wood work, saving of seams and saving of time in measuring and making dimension sketches. Its only disadvantage is the comparative difficulty of bending, which is not serious. The one advantage of the latter method is the comparative saving of time in forming, its disadvantages being sharp bends, except when certain brakes or dies are used, discrepancy between the profile of the lining and that of the trough, thus leaving the lining improperly supported, multiplicity of seams to make outside of the shop, and time consumed in measuring dimensions and making sketches.

A gutter like that shown in Fig. 56 is very easily made and applied, and can be satisfactorily formed on a brake, as the hight of the wood core above the roof is the same at all points, the pitch of the gutter being obtained by placing the core

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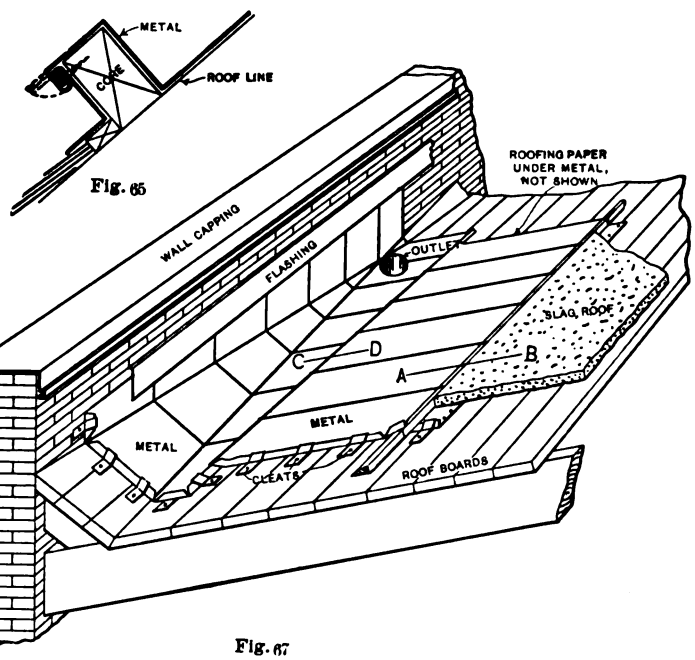
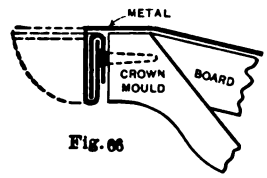
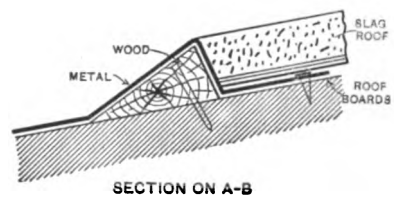
at a slight angle with the eave. When the metal is not wide enough to form the entire stretchout in one piece, a lock seam is usually made at "a," Fig. 56a, as indicated in Fig. 65.

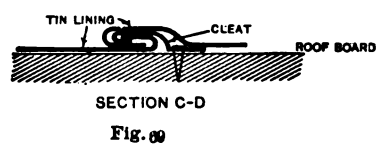
What has been said about the gutter, Fig. 63, applies to the gutter, Fig. 57a, but, as the latter must be neatly finished over the outer edge of the crown mold, something will be said on that point.

A method of finishing a gutter edge is shown in Fig. 66, which has been found effective and economical. Strips of galvanized iron are cut and bent at right









Construction of Gutters

angles in the brake or bar folder, to form angle pieces 5-8 inch on one side and $\frac{1}{8}$ inch less than the width of the face of the crown mold on the other. The narrow leg of the angle is then nailed to the face of the crown mold with the wide leg flush with its top, the gutter lining is then hooked over the wide outstanding edge. All is bent down together as far as possible with a pair of roof tongs, and then laid up close to the face of the mold with a block and mallet, thus no nails or raw edges are left exposed.

In a gutter, as shown in Fig. 64, the pitch is usually obtained by running the bottom line of the gutter at an angle with the wall, which varies the width of member "a." Therefore, the best way to manage this gutter is to turn the locks on the flat sheets, first tinning the edges, if copper is used, and then take the

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material to the building and lay it directly in place, as shown in Fig. 67, using cleats, not under edge nails. Heavy roofing felt should be used under the metal.

In some cases, where the girth admits, the gravel edge can be made in the shop on the brake, and used without support; but, as a rule, it is better to nail a $\frac{3}{4}$-inch wood ground strip on the roof and form the metal over it, thus having the otherwise unsupported gravel member protected against crushing if stepped on.

Fig. 68 is an enlarged sectional view on line A B of Fig. 67 and Fig. 69 a similar view on line, C D.

Thoroughly solder the seams and cap flash the edge against the wall with heavy sheet lead, extending at least 2 inches into the wall in moderate climates and 4 inches in cold climates. It is always best to build in the flashing as the wall is laid.

All tin or galvanized iron gutter linings should be thoroughly painted on the under side long enough before laying to allow the paint to dry.

Attention has been called to the likelihood of the nails in the lower edge of the gutter, shown in Fig. 63, being drawn out by the sun. Other methods of

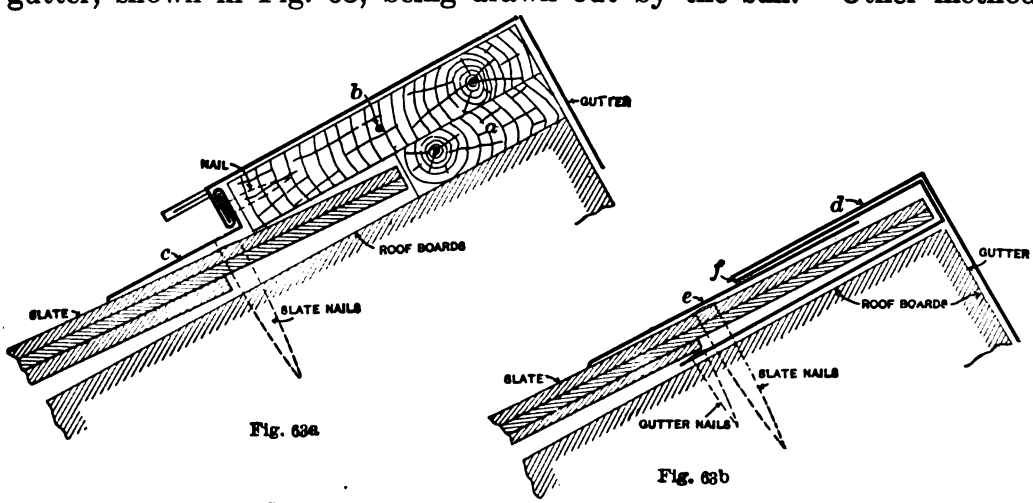

Fig. 63a Fig. 63b

Improved Methods of Slate and Lining Connection

finishing this lower edge are, therefore, shown in Figs. 63a and 63b, which obviate the difficulty mentioned. The entire gutter is not shown, it being deemed sufficient to show the edge to be finished. Referring to Fig. 63a, it will be seen that a wood strip, *a*, is nailed on the roof flush with the lower edge of the wood gutter, against which the slate finishes. The thickness of this strip should equal the thickness of the slate roof. On top of strip *a* another strip, *b*, about twice as wide as strip *a*, is nailed. Strip *b* extends down over the slate about 2 inches. To the lower edge of strip *b* a metal strip, *c*, is nailed, as shown, the top edge of which is turned down parallel with the upper surface of strip *b*. The gutter is locked on to this edge, as indi-

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cated by the dotted lines, and then double seamed down over and forming a covering for the nails which secure the metal strip *c*, and at the same time securing the lower edge of the gutter, by means of the seam, in a neat and substantial manner.

In executing this finish the first thing to be done is to nail the strip *a* in position; then finish up the slate roof, after which wood strip *b* is nailed in place, the metal strip *c* applied, and the gutter double seamed thereto. It will be noted that metal strip *c* covers the nails which secure the upper course of slate.

Another method of finishing the lower edge of roof gutters, shown in Fig. 63b, is by means of a slate pocket. It will be seen that the pocket, *d*, is formed on the lower edge of the gutter into which the slate finishes. A separate strip, *e*, is then inserted into this pocket for the purpose of covering the slate nails. Strip *e* is secured in place by soldering to the gutter at intervals at the point *f*. As there is no strain on this strip, securing by solder is a durable method.

Either of these methods can be applied to gutters as illustrated in Figs. 56a and 63 respectively, or to any form of roof gutter the lower edge of which finishes over a slate, shingle or tile roof.

PRACTICAL TALKS ON GUTTER WORK—IV

In getting out and putting up copper wall gutters like those shown in Figs. 60, 61 and 62, the following methods have been found to be good: Assuming that patterns and measurements have been provided, the next step is to lay out a dimension sketch or plan of the gutter, as in Fig. 70, indicating and marking the length of each sheet or section, as shown. Then cut and mark the stock according to the sketch, being careful to do all marking on the inside surface of the gutter so that the brake man will know how to form the pieces, right or left. Also mark the surface of each lap to be tinned. It is only necessary to tin contact surfaces. Now, tin the laps, and form the gutter, except the bend *a*, Fig. 71, which should generally be made when the gutter is set in place on the wall, as it is difficult to make this bend in the shop, so that the member *b* will vary in the exact proportion necessary to suit the pitch of the gutter.

In the meantime the gutter bars and dogs should be prepared. The bars should be cut a trifle shorter than the length of the gutter sections, measured on the outer edge of course, and punched for the dog rivets. The dogs should be cut, punched and twisted, and the end which rivets to the bar bent, leaving the roof bend to be made outside with a properly constructed pair of bending wrenches.

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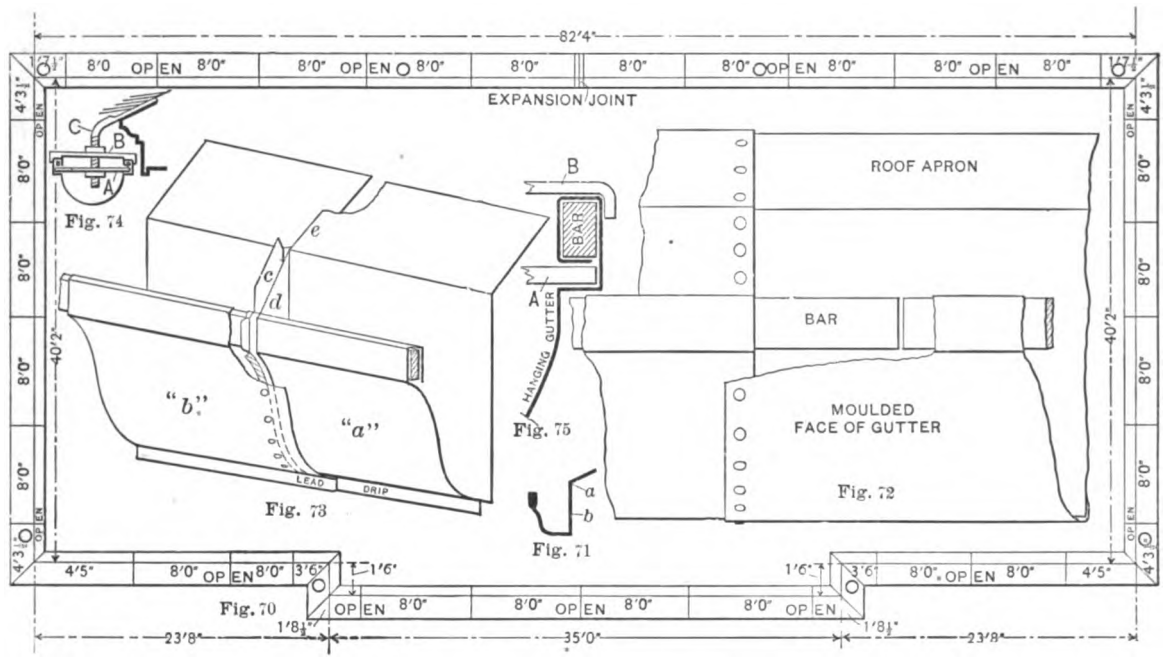
Now put the gutter together in 16-foot sections, or as shown on dimension sketch, Fig. 70, "open" indicating the seams to be made at the building, and put in the bars, being careful to allow the bars to project several inches out of one end



Construction of Hanging Gutters

of the gutter section, leaving it that much short at the other end, so that when the sections are joined on the building, the joints of the gutter and bar respectively will be dodged or broken, as indicated in Fig. 72, which avoids weakening the gutter at the joints.

Before the bar is put into the gutter it should be laid on the outer face of the same, and the dog rivets holes marked on the copper, so that after the bar is folded in place there will be no difficulty in locating and punching the holes through the copper.

As the dimension sketch, Fig. 70, shows a straight stretch of gutter over 80 feet long, it is necessary to use an expansion joint constructed as follows: Referring to Fig. 73, it will be seen that the two adjacent sections of gutter each have end heads, *c* and *d* respectively—that is, section *a*, being placed at the extreme end of the section and the top edge cut off on a line drawn from the inner top edge of the gutter bar to the roof bend, while the end head *c* in section *b* is placed about 1½ inches back from the end of the gutter section and projects up about 1½ inches above the end head in section *a*, as indicated. When the gutter is put up sections

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a and *b* are laid together end to end, as shown, with a space of about ⅛ inch between the respective end heads, the lap *c* is bent down over *d*, and the roof apron seam, *e*, well soldered.

In putting up gutters of this kind the use of nails driven through the bottom or back of the gutter for the purpose of holding it down to its seat should be avoided, as the dogs are amply sufficient for this purpose when properly formed and secured. The dogs should be riveted to the bar with large copper rivets and secured to the roof with large tinned wrought iron nails well soldered and wiped around. In soldering or wiping around the dog nails a gasoline torch should be used to heat the dog nails and surrounding copper so as to insure the thorough soaking of the solder under and between the entire contact surface of the dog and copper, thus removing the possibility of the entrance of water through the holes pierced in the copper by the dog nails.

In making the "open" seams the torch should be used to warm the bar member and enable the solder to flow completely around the bar,so that the seams will be watertight up to the top edge of the bar. It is difficult to accomplish this or successfully solder the dogs if the heat of a soldering copper alone is depended upon.

The gutter seats on walls are usually pitched to the outlets, but in putting up "flat back" hanging gutters it is left to the metal man to look out for the pitch, there being no wall seat, therefore it is advisable for him to use a spirit level in setting such gutters, as the builders cannot be depended upon to leave the roof eave exactly horizontal. In the rare cases where the eave is left exactly level the roof bend of flat back gutters can be made in the shop with safety, it only being necessary to lay the loose pieces end to end in a straight line, forming stretches of gutter on the floor, locate the roof bend at each end, allowing for pitch, connect with a chalk line and bend the several component pieces in the brake at the chalk mark. It would be a simple matter to figure the location of the roof bends in all gutters if the masonry or carpenter work was accurate, but such is seldom the case.

Ordinary eave trough hanging gutters, which together with the hangers can be bought from stock, is too well known to justify description, but a special hanging gutter now being largely used by New England's leading architects will be briefly described.

A general view of this gutter is shown in Fig. 74, and an enlarged section through one end in Fig. 75. It will be seen that the bars are not punched, there being a horizontal longitudinal recess left under same which receives the end of

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the supporting dog. A and B is the clamping dog. The threaded roof dog C passes through both the clamping and supporting dogs and is provided with a nut below the latter and another nut above the former. It will be seen that the threaded and nutted roof dog not only carries the gutter but provides for the pitch; the supporting dogs A connect the gutter with the roof dogs C, and also prevent the sides from moving inwardly; the clamping dogs B prevent the sides from spreading, and being about ¾ inch distant from the supporting dog, forms together with same a support or fulcrum that braces the gutter against tilting or twisting when stepped on or struck by ice on its outer edge. The roof dogs are countersunk into the roof boards and secured by two large screws, and the gutter are usually constructed easily carries the weight of a man.

HINTS ON MAKING CONDUCTOR PIPE AND EAVE TROUGH

These are the methods adopted by a successful sheet metal worker and are presented here for a guide to others when equipping a sheet metal working shop for making articles so that they will be regular in size and thus avoid annoyance. In my shop a varied line of sheet metal work is done, yet I have a great deal of demand for eaves trough and conductor pipe; as I am frequently called upon to repair, renew and extend some of my work, it is important that the size shall be regular to avoid trouble and expense.

In making these articles I use an 8-foot cornice brake, a groover and edger and a crimping machine. Conductor pipe is made in 30-inch lengths, with a grooved seam that is flattened down tight with a mallet and tacked with solder in the center. At the squaring shears, I have a gauge for every size of conductor pipe—2, 3, 4, 5 and 6-inch—so that every piece of pipe that is cut is exactly the same in size and we never have trouble in getting them to fit.

We cut all the tubes connected with eave trough ⅛ inches smaller than the conductor pipe. This saves a lot of trouble, and it is surprising to see how easy it is to connect a conductor pipe when it will slip up readily over the gutter tube or outlet.

For eaves trough I use what is commonly known as the ogee gutter in every possible place where I can, as it is easy to form, easy to rivet together in lengths, easy to solder, easy to paint, and, what is most important, it always looks well and pleases almost everybody.

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As will be seen from the illustration, a sharp, square bend is avoided in order to prevent breaking the galvanizing. At the top the front is bent as shown to form a finish, and a double edge is provided to give strength. At intervals varying with the size of the gutter, braces are riveted to strengthen the gutter as shown in the sketch.

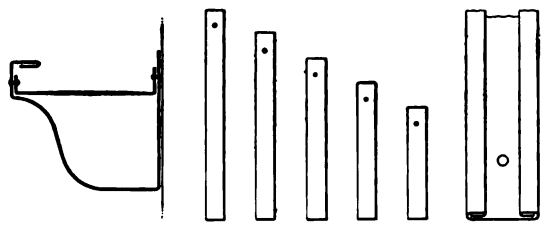

Fig. 76.—Section of Eaves Trough and Conductor Gauges

My down-spout or conductor-pipe gauges are made of galvanized iron 2 inches wide and have a double edge. They have a hole punched in one end so they can be hung up, and the size is marked on them with a prick punch so there can be no mistake.

EAVES TROUGH FOR 30-FOOT RADIUS

It is probable that if the eave trough is erected in relatively short sections that even from a close distance it will have the appearance of conforming to the circular line of the building without itself being curved. Assuming that it may not be convenient to obtain eave trough in lengths as little as 4 feet, 8 foot lengths could be cut in two. Then the effect of using straight sections 4 feet long can be brought out by reference to Fig. 77. This shows a portion of a plan of the roof in which the distance from A to B, or radius of the curve, is 30 feet. The drawing is not to scale, but will serve to indicate the idea and on that account does not need to be drawn strictly to scale.

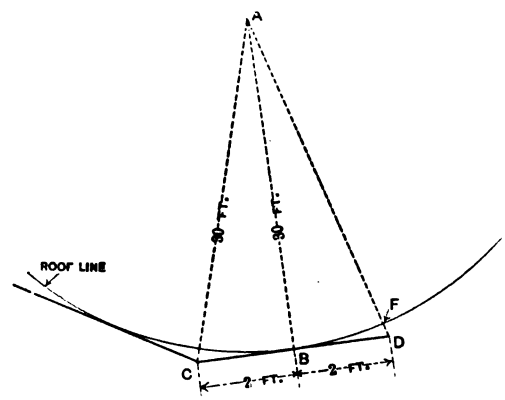

Fig. 77.—Eaves Trough for Roof 60 Ft. in Diameter

Suppose that a section of the eaves trough is laid with its middle point perpendicular to the end of the radius at the point B, so that its end C extends 2 feet one way from the radius A B and the other end D also 2 feet. If we connect the points A and D this line will cut a circle of the outline of the barn roof at some point as F. Obviously, the distance A F must be 30 feet, so the interesting thing is to determine the length of the line F D, or how far from the curve of the barn roof the end of the 4 foot length of eaves trough will lie. The line A D is the hypotenuse of a right angle triangle of which the sides are 30 and 2

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feet long. Its length is, therefore, equal to the square root of the sum of the squares of the lengths of the two sides, or the square root of the sum of 900 and 4, or 30.60. This indicates that the length of the line F D is 0.06 ft., or about ¾ in. Whether it would be advisable or possible to spring the eaves trough a matter of ¾ in. in a length of 2 ft. may be a question, but it would seem that if eaves trough of about this length were erected so that one section slipped into the end of the other with a slight angle, the eaves trough could be built to conform as closely as needed to the outline of the roof. It is possible that it would be advisable to put up the 4 ft. lengths so that the center in each case lies slightly within the circle of the roof edge, bringing the ends of each section slightly beyond the circle.

GUTTER AROUND A CIRCULAR CORNER

Flaring strips must first be cut for the various sections of the gutter; then raised and stretched to the desired profile and curve of the veranda, as follows: First, draw the profile of the gutter, as shown by A B C D E in Fig. 78, and 3 feet from the eave line D draw the vertical line *c a*. Divide the profile of the gutter into as many spaces as the gutter is to have sections, which in this case are four, as shown by A B, B C, C D and D E. Then through A B average a line, as shown, intersecting the vertical line *c a* at *a*. In a similar manner average lines through B C, C D and D E, intersecting *c a* at *b*, *c* and *d*, respectively. With *a* as a center strike the blank or pattern J, obtaining the stretchout from A B, and adding for the wire, as shown. In a similar manner obtain the blanks H, G and F, using *b c* and *d* as centers. Edges are allowed to the patterns, as shown. After being raised and stretched the pieces are joined by riveting and soldering, as shown in diagram X, where the wire is shown by A^1 and the various positions of the laps by B^1, C^1 and D^1. The blanks J and H are raised in pieces about 30, or 36 inches long as shown in Fig. 79, where A is a wood or lead raising

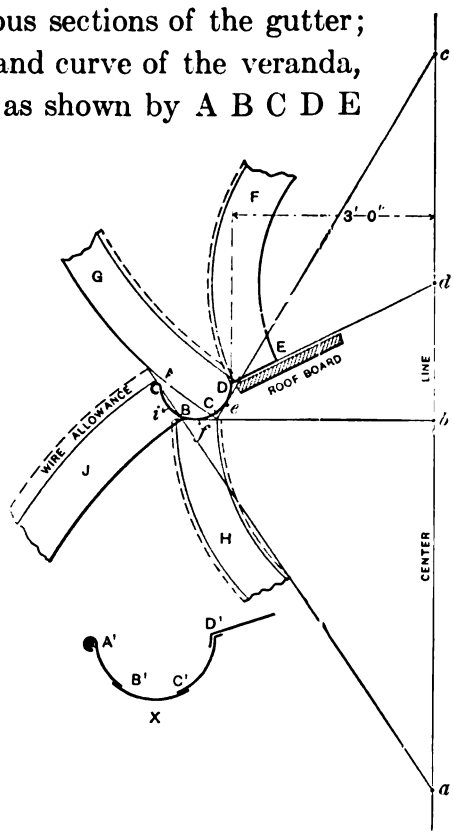

Fig. 78.—Gutter Around a Circular Corner. Obtaining the Blanks

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block, B the proper sized raising hammer, and J or H the blank. The center of the blank is first hammered; then the buckles are drawn out along the edges. While A B and B C, in Fig. 78, are raised on the block, C D must be stretched, as shown in Fig. 80, in which A is the mandrel or blowhorn stake, B the stretching

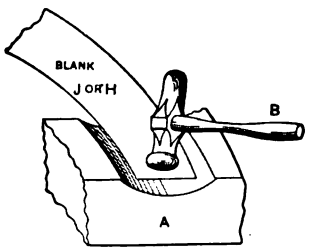

Fig. 79.—Raising Blanks J and H

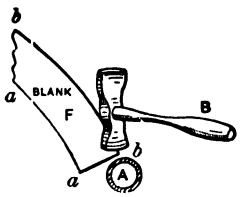

Fig. 80.—Stretching Blank F

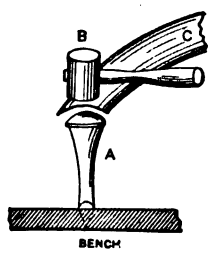

Fig. 81.—Dressing the Molds

hammer and F the blank, which is stretched along the edges *b b* and *a a* . When the blanks have all been formed to their required shape they are dressed upon the round head stake, as shown in Fig. 81, by placing the mold C upon the stake A and using the mallet B to take out any buckles. Some little skill is required upon the part of the mechanic to bring each mold to its proper shape.

BEADING GUTTER WITH HAND TOOLS

In the accompanying illustrations are shown the four operations employed for beading gutters by hand.

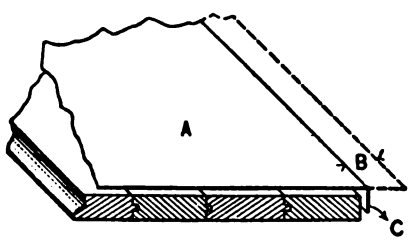

Fig. 82.—Beading Gutters. Bending the Sheet

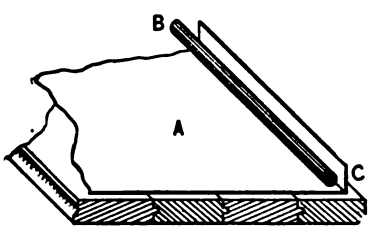

Fig. 83.—The Position on the Bench

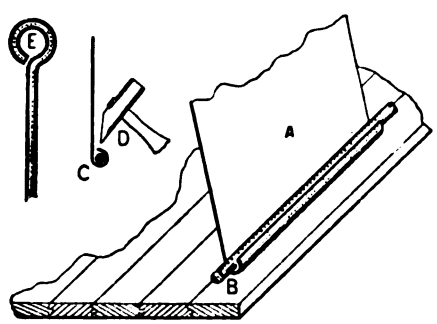

Fig. 84.—Bending the Sheet

In Fig. 82, A shows the sheet of metal on the bench projecting over the edge of the bench as far as B (the amount of material required to incase the bead). It is then turned down with the mallet, as indicated at C. This first operation could be avoided by making a bend in the brake as shown at C. The second operation is indicated in Fig. 83, where the sheet A is laid upon the bench with the edge C turning upward. Now

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take the required size rod or gas pipe, place it as shown at B, and using the mallet turn the metal C over the rod, when it will look as shown at A in Fig. 84. Then, holding the sheet in the position there shown, turn the metal tightly around the rod B, as shown in diagram C, using the sharp edge of the hammer D, being careful not to make any dents on the sheet A. When this operation is completed the rod is tightly incased.

To remove the rod so that the other sheets can be beaded, lay the sheet A flat upon the bench and tap lightly along the bead with the mallet, when the rod can easily be drawn out. In shop use the rods have a ring at one end, as at E, from which they hang against the wall. This is also used to draw the rod out of the sheet after it is beaded.

GUTTER SUPPORT AND BRACE

The accompanying illustration Fig. 85, shows how to fasten an ogee gutter to a building without disturbing the shingles. Form the sheet metal cylinder just the right length on the gutter beader, then solder the sleeves, which serve as braces, into the gutter at sufficiently frequent intervals to insure support of the gutter without strain when fastened to the building. The fastening is accomplished by a nail about 3-10 × 7 inches, which is driven through the face of the gutter and passes through the sleeve and the back of the gutter and firmly into the fascia or board that finishes the building at the eaves just under the shingles. When a sufficient number of these braces and nails are used experience has shown that good service is rendered.

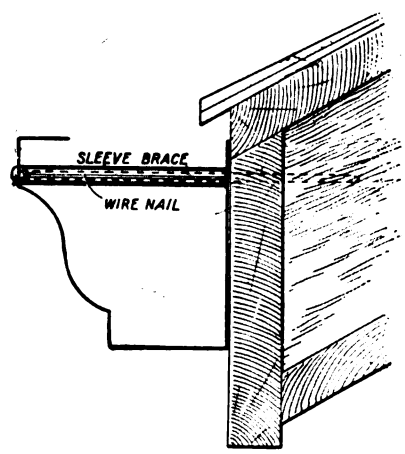

Fig. 85.—Gutter Support and Brace

HANGER FOR EAVE TROUGH

The hangers are easy to make, cheap and durable, and the wind does not blow the trough down let it blow ever so hard. Use No. 19 hoop iron, ¾-inch wide, cut 21 inches long, for shortest hanger for the ordinary trough, made from tin cut 7 inches wide. Use No. 18 hoop iron, ⅞-inch wide, for the trough made from tin

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9¼ inches wide. Starting with the shortest strip, cut each subsequent one about ½ inch longer, to allow for fall of trough. Two nail holes are to be punched in each end of the straps, which should be placed about 3½ feet apart on the building. Ordinary hoop iron can be used for the hangers, but if painted or galvanized they

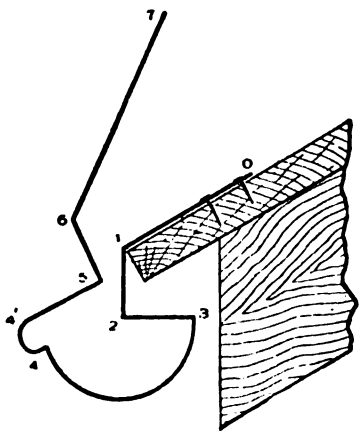

Fig. 86.—Hanger in Position for Receiving Trough

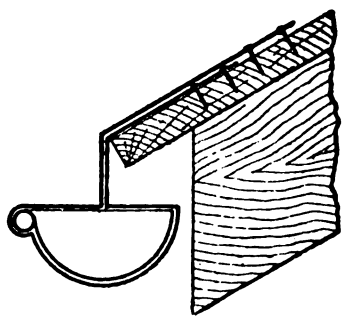

Fig. 87.—The Completed Trough and Hanger

are much more durable. The hangers are formed as in Fig. 86, which shows one in position on roof to receive trough. When forming the hangers, the bends are to be made in the order indicated by the figures; the first bend is made at 1, the second at 2, etc. The increase in length of hangers to allow for proper fall of trough is allowed for between bends 1 2 and 5 6. The hangers having been nailed to the roof, as shown in Fig. 86, and the trough soldered in as long a length as can be handled, the ladder is placed against the building where the center of the trough is to come, and the trough carried up and placed in the hangers. The two nearest hangers are then to be nailed to the roof, when the ladder can be moved to the highest end of the trough and the other hangers nailed as shown in Fig. 87, and so continue until the lower end is reached, when the ladder is in position for putting up the conductor pipe.

A HOME-MADE BEADER

The bed of the machine Fig. 88, is made of a piece of 4 × 6 yellow pine 8 feet 6 inches long. The top of this stands 30 inches above the floor, and is supported by four legs, which are secured to the bed piece by means of bolts running clear through. These legs have a cross brace at the bottom, from which angle braces

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run up to the bed piece. On the top of this a piece of 1-inch brass pipe is secured by means of cast iron angle pieces, as shown in Fig. 89. These angle pieces are fastened to the bed by wood screws. Another part of the apparatus is made of a piece of 5-8 inch round machine steel. The piece of steel and a pipe were taken to a machine shop and the pipe had a slot $\frac{1}{8}$ inch wide cut in it lengthwise its entire

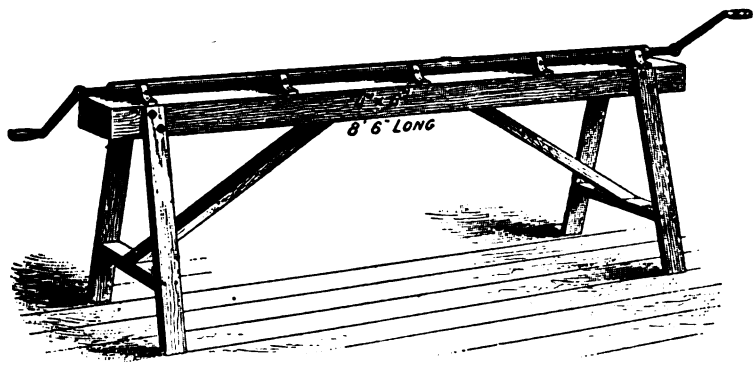

Fig. 88.—A Home Made Beader. General View

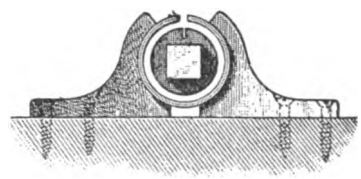

Fig. 89.—Sectional View of Beader and Clamps

length, 8 feet 3 inches. The piece of machine steel had a slot cut in it 1-16 inch wide and $\frac{1}{8}$ inch deep for its entire length; and each end was squared so that a crank could be attached to it. After the pipe was fastened to the bed by means of clamps, the steel beader was run through it and the cranks attached, when the machine was ready for use. By inserting the sheet iron in the slot in the beader and by turning the crank at each end so as to reduce the strain on the steel beader shaft, a bead could be formed on a piece of galvanized sheet iron 8 feet long.

A CHISEL TO CUT THE BEAD OF THE PATTERN OF EAVE TROUGH MITERS

Those who have had occasion to make miters in the half round hanging gutters that are generally used know the difficulty and the tediousness of cutting the small curves on the edge where the bead is formed. In the engraving herewith, Fig. 90, is illustrated a steel chisel and is shown a piece of sheet metal along which the miter pattern has been marked out, with the chisel applied to the pattern where the smaller curves occur, so that by one blow from the mallet when the metal is laid on a suitable block, these curves are cut in much less time and with much less labor than would be possible with the ordinary hand snips or bench shears. The chisel is made from a piece of 3-16 $\times$ $2\frac{1}{2}$ inch flat steel. The steel has been formed together to make a handle to facilitate its use and a head on which the blow

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may be struck. The cutting edge is forged and shaped to the curve desired, after which it is ground sharp to do the cutting. The tool is so simple that it can be readily made by all who desire to benefit by the labor saving attending its use. Of course the balance of the miter is cut with the snips; and it is well to dress down the burr, formed by cutting with the chisel and snips, by laying the material on the smooth surface of a block of cast iron and striking with a mallet the surface of which has been rasped smooth. It is to be understood that such little kinks for the shop as this are of positive value; still it is advisable to install a press (power, if power is available) with the proper dies to cut and prick mark these miters thereby saving time; providing of course that sufficient quantities of gutters, etc., are sold to warrant the investment.

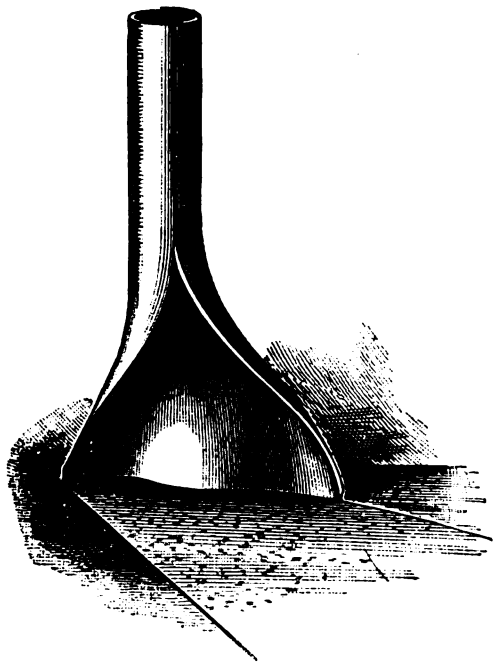

Fig. 90.—Cutting Gutter Miters

HANGING LONG EAVE TROUGH

Many different styles of eaves are met with, and different styles of gutter and hangers are used. In hanging gutter on a barn 80 feet long put up the gutter in two sections of 40 feet each. When the eave projects considerably without any back strip nailed to the end of the rafters, always have one put up 6 inches or more wide according to the pitch of the gutter. Then nail gutter straps to it about 2½ feet apart, as shown by Fig. 91. Make them out of good tin painted on both

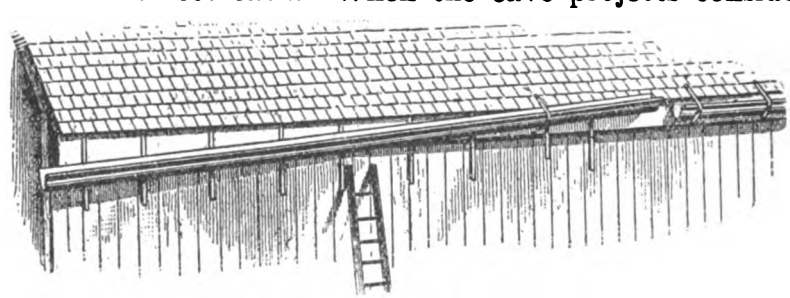

Fig. 91.—Hanging Long Gutters

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sides, and cut them 1 inch wide and 28 inches long. At the center of the strap rivet or solder another strap half as long to hold the gutter from being lifted up in a wind storm. Having nailed up the straps make a loop of one, as shown in the illustration, about 10 feet from the high end of the gutter, for the work should always commence at the high end. Now place the ladder about 20 feet from the end and pick up a section of the gutter at the middle of the 40 feet and mount the ladder, when if it is not a windy day, one end of the gutter can be easily pushed through the loop and the gutter secured by another loop near the ladder. After this, by moving the ladder the other straps can be fastened so as to give the gutter a proper pitch, and the first section is completed. The second section is put up in the same way, and when it is secured the two sections are connected and the straps fastened to maintain a proper pitch through the entire length. When all is securely fastened the open seam between the two sections must be soldered; this completes the work ready for the conductor to be attached to pipe at the low end of the gutter. Solder the down straps under the bead of the gutter about 10 feet apart, and when properly nailed they hold the gutter securely in place, and the strongest wind will not lift the gutter out of the straps or destroy the pitch.

HOLDER FOR EAVE TROUGH

For a holder when soldering eave trough, make a sheet-iron cylinder, A B C, Fig. 92, the diameter of gutter and 4 feet long, or longer if desired. Form a strip of iron the length of cylinder and rivet to same, as shown at D. This forms a straight edge for the bead on trough to rest against. Then form two or more wire springs, as shown by E F G, for holding the trough in position while soldering. These springs are to be hinged to the cylinder as at G, and bent so as to go over the bead and lock over D, as shown at E. The springs are hinged at G, so they can be turned back to release the trough after it has been soldered. Then cut two disks from 1-inch board to fit in the ends of cylinder and which can be secured in place by nailing. In the center of each disk, as at M, drive a wire for the cylinder to revolve on. A 6-inch board, K L, for stand, and two 8-inch uprights, similar to H J, complete the machine.

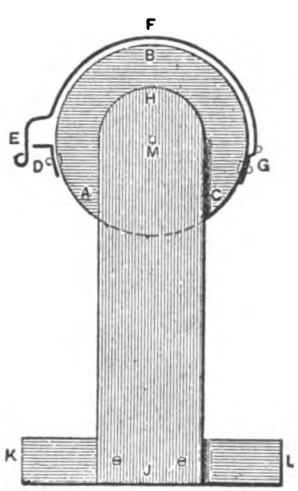

Fig. 92.—Holder for Eave Trough

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EAVE TROUGH HANGERS

Pieces of tin that are from 18 to 20 inches long are cut into strips 1 inch wide and used for stays, as shown by A in Fig. 93. These stays are brought around under trough, nailed to cornice, and placed 6 or 8 feet apart. Shorter strips, from 10 to 16 inches in length, are used for the uprights B, and are bent around the cross bars C and soldered to same. The cross bars C are made from pieces of tin 1¼ inches wide, and from 3 to 6 inches long, according to the size of trough they are intended for. These cross bars are formed in triangular shape, placed with the opening down, in top of trough, and soldered at the ends. D represents a piece of 1¼-inch hoop iron cut 10 or more inches long, having a slot in one end and provided with holes for nailing to roof. D is nailed to the roof, as shown in Fig. 94, the upright B passed through the slot and drawn up so as to give the trough the proper slant. The upright B is then cut off 1 inch above D, the ends bent over each way and under, being pinched close

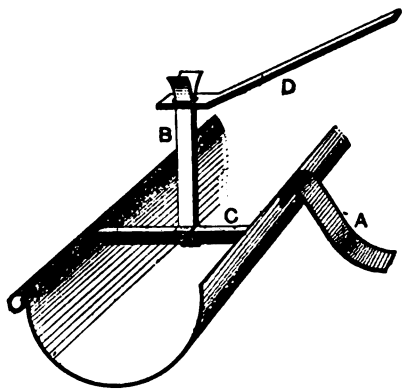

Fig. 93.—Eave Trough Hangers. Various Parts of Hangers

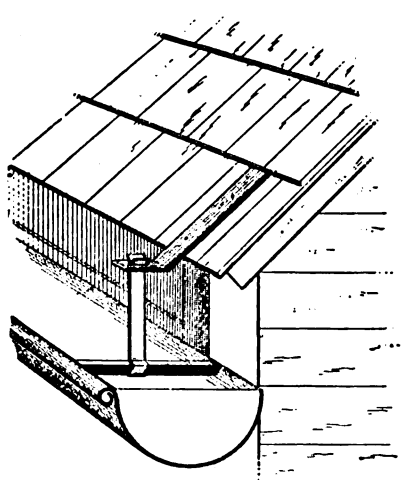

Fig. 94.—Trough Attached to Roof

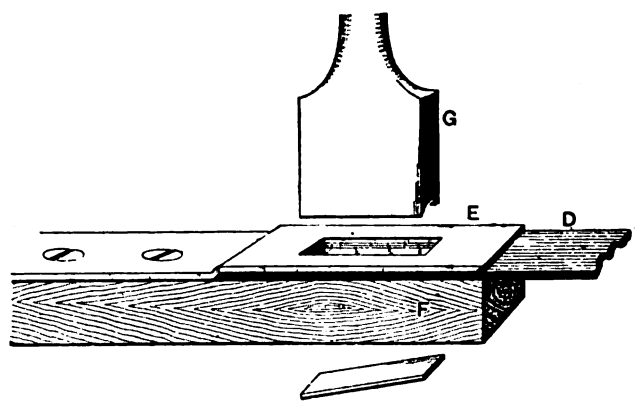

Fig. 95.—Die and Punch for Cutting Slots in Band Iron

with the flat pliers. In Fig. 95 is shown the die used for punching the slot in the end of hoop iron. The die is represented by F and attached to it is the guide E, which allows the hoop iron D to pass in the proper distance and insures the punch being placed over the opening in die. The punch G is represented in proper position for punching the band iron D. The punch and die can be made by any blacksmith and should not cost over 50 or 75 cents.

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AN EXPANSION JOINT FOR GUTTER LINING

The greatest trouble in using copper is in making the proper provision for taking care of the contraction and expansion, and in this connection it is well to remember that this is much greater in copper than in any of the other materials used for lining gutters.

Copper expands or contracts 0.0115 inches for each 100 feet of length for each degree of difference in temperature. This means that a piece of gutter lining 100

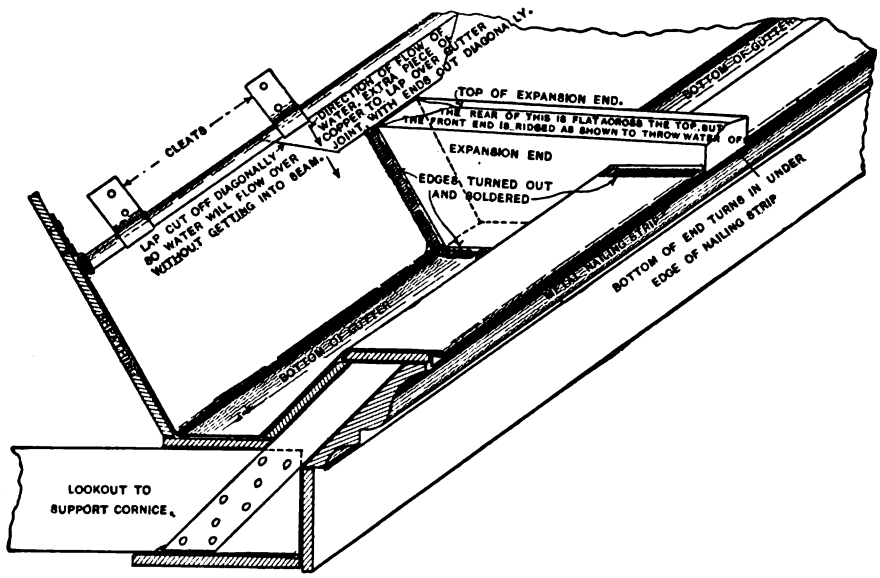

Fig. 96.—Arranging for Expansion in Copper Gutter

feet long will expand nearly $1\frac{1}{8}$ inches in length in a difference of 100 degrees of temperature. As the actual difference between the extremes of the coldest weather in winter and the hottest weather in summer is considerably more than this, the amount to be taken care of is still more than the amount stated above.

It is probably safe to assume that the maximum variation in temperature from the coldest weather in winter to the hottest weather in the sunshine in the summer will be 150 degrees. On this basis, it will be seen that the amount of expansion in a gutter lining 100 feet long will be 1.725 inches, or practically $1\frac{3}{4}$ inches. Now, if this gutter is put in during the maximum heat of the summer, without making provision for the contraction, it will be found that a number of the seams will be broken from the strain put on the gutter by the contraction of the copper, which will be shortened $1\frac{3}{4}$ inches, as there is no way to prevent the contraction. On the other hand, if the gutter is put in during the severe weather of the winter,

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without making provision for expansion in the summer heat, this expansion will add $1\frac{3}{4}$ inches to the length of the gutter, which will cause it to buckle up in heavy ridges, and then the contraction of the copper will cause these ridges to crack. Obviously the proper way is to exercise judgment and common sense in using this material and to take into consideration the temperature prevailing when the gutter is put in.

Regardless of the temperature neither edge of the gutter should be nailed under any circumstances. The outer edge should be locked to a strip nailed to the outer edge of the gutter board and should be locked so it can slide along freely when contracting or expanding.

The inner edge should have a half-inch turned and should be cleated. All cross seams should be heavily tinned on both sides of the metal before being edged;

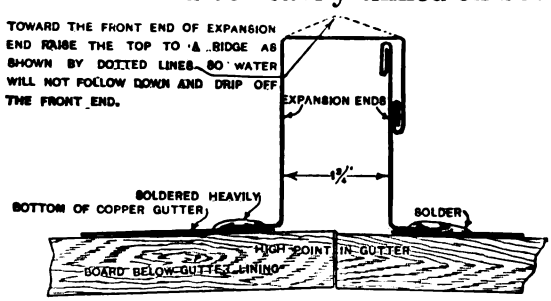

Fig. 97.—Gutter Expansion Joint in Cold Weather

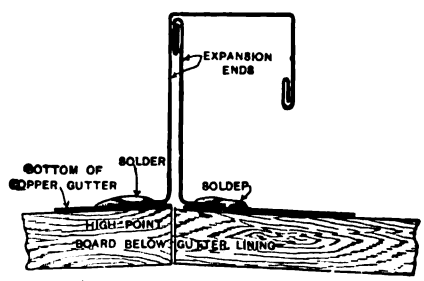

Fig. 98.—Gutter Expansion Joint in Hot Weather

the edges should be $\frac{1}{2}$ inch wide, the lock well hammered down and heavily soaked with solder. Too much stress cannot be laid on thoroughly tinning the sheets on the ends for the locks, turning edges $\frac{1}{2}$ inch wide and soaking the solder in well, for these seams are subjected to great strain. If there is very much of this work it would be best to tin the sheets on the ends by dipping them and then letting as much of the solder as will cling to the ends of the sheets remain on them. Then, when the seams are soldered, this solder amalgamates with that soaked into the seam and makes a solid joint all the way through.

So far the preparations and instructions are the same, regardless of the season, but the work at the job must be carried out with due regard to the temperature. For instance, if the gutter lining is put in when the temperature is at the lowest that it is likely ever to be it will not be necessary to make any provision for contraction, but a piece of gutter 100 feet long should be free at one or both ends to the extent of $1\frac{3}{4}$ inches or $\frac{7}{8}$ inches for a gutter 50 feet long.

Supposing we have a piece of gutter 100 feet long, draining to both ends, with a high point in the center. We should put this in place in two pieces which

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will lack at least 1¾ inches of coming together, and then we should solder an end piece in each gutter at the high point, with the top of this piece as high as possible, but at any rate at least 1 inch higher than the outer edge of the gutter. (See Fig. 97). These two end pieces should be set not closer than 1¾ inches, as in the warmest of the summer weather the expansion of the copper will be sufficient to bring them together.

The part of the rear of the gutter which extends above the end pieces should be lengthened by soldering on an extra piece until it will lap over on the other piece about as shown on Fig. 96; but it should not be soldered to this piece on both sides, but left free on one side for expansion and contraction. This should also be cut off on a bevel at the end, as shown, so the water will run across the seam. One of these ends should bend over on top square 2 inches and then turn down 1 inch or more to keep the water from getting in between the two end pieces. A section through these joints would show like Fig. 97. This shows the positions of the ends when the temperature is lowest.

In the hottest weather of summer they will be close together, like Fig. 98. If the gutter lining is put in during the hottest summer weather the ends should be close together, as shown in Fig. 98, as the lining gutter will then be at its maximum length and all the provision should be made for contraction.

As the gutter lining will seldom be put in during either extreme, it will be necessary to use judgment, and to decide according to the temperature prevailing how much of the allowance should be made for expansion and how much for contraction. In considering this the writer assumes that the lowest temperature to which the gutter lining will be exposed will be 30 degrees below zero and that the maximum will be 120 degrees. Then, when putting in gutter lining when the temperature is about 45 degrees above freezing point, we would make equal provision for expansion and contraction, and in placing the two ends would set them ⅞ inches apart, which would give us an allowance of ⅞ inches for expansion and ⅞ inch for contraction.

In figuring on copper work it is necessary to figure that the labor will cost considerably more than for tin as it requires more time to do the work, and in addition to this the man who pays a "copper price" expects "copper quality," and he is entitled to it. Great care should be taken to get the material in smooth and free from buckles, as these mean broken places in the gutter. If these directions are followed there should be no complaint where copper is used, and it should last indefinitely and without expense for painting and repairing.

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GUTTERS IN WOOD WORK

Two different types of boxed-in gutters, designed not only to carry away rainfall but also to prevent any damage by snow slides, are the subject of the accompanying illustrations. On flat roofs having a slope of less than 2 inches to the foot there is, of course, no need for protection against snow slides—at any rate in the case of porch roofs where the snow will melt and run off before it slides. The gutter shown in Fig. 99 is finished with 20 × 28 inch terne plates made up in rolls 28 inches wide. The strip of tin extends upward underneath the shingles about 12 inches at the high point of gutter and about 6 inches at the low for it s not necessary to trim unless it is desirable to have the waste tin; where it is fastened. While the low er edge projects straight downward over the cornice, forming a drip edge, so that water collecting toward the edge of the gutter can fall clear of the cornice. This makes a gutter wide and deep enough for an ordinary roof. If a more ornate finish is desired it may be secured by soldering a ½-inch roll on the drip edge described, this arrangement not interfering with the free fall of the water.

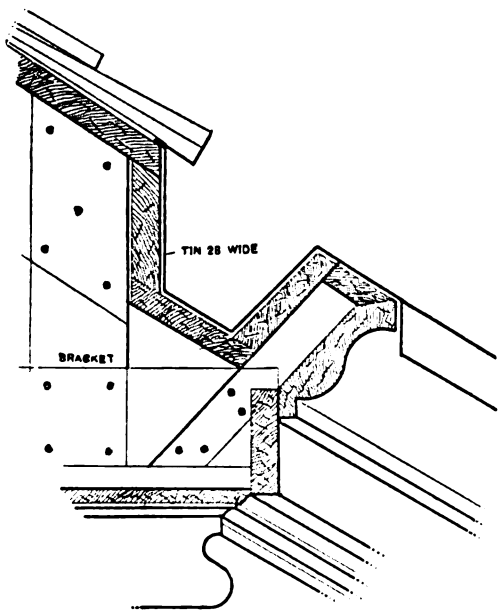

Fig. 99.—A Cornice Gutter

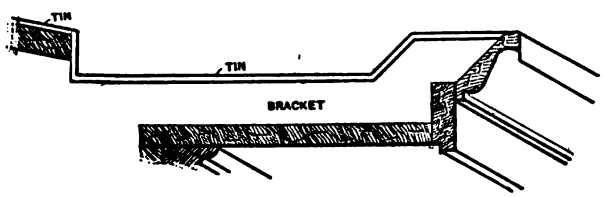

Fig. 100.—Gutter on Porch Roof

The gutter shown in Fig. 100 is applicable to flat roofs. The particular style as a part of a porch roof, made wide to accommodate the architectural conformation of the bracket and cornice. This is a form of construction such as may be used to extend an old roof line to improve appearances. The tin of the roof is formed into the shape of a gutter on the new wood work and carried over the edge of the cornice, as in the case of the gutter shown in Fig. 99. The gutter of this description provides a wide waterway and can be easily placed on an old building to take the place of a hanging gutter.

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FORMING RIDGING AND GUTTERS ON THE CORNICE BRAKE

When a ridge roll is to be formed, as shown in Fig. 101, the operations are similar to those shown in Figs. 102 to 105, inclusive.

First, find the girth of the ridge roll shown in Fig. 101 and make the square bends as indicated by 1 2 3 and 6 7 8 in Fig. 102. Place 1 2 3 in the recess between the top clamp B and the bottom clamp C, as shown by 8 1, and close the top clamp B on dot 4. Then make a square bend, as shown by A 1. Leaving the sheet in this position, as shown by A 1 in Fig. 103, place the required size former *a* in position, fastening it by the clamp *b*. Press down A over the former until it has the position shown by B.

Release the former and reverse the sheet and place it in position, as shown by B 1 in Fig. 104. Close the top clamp on dot 5′ and make a square bend, bringing the sheet in the position shown by 1° B. Leaving the sheet in this position place the former *a* in position as shown in Fig. 105, and press down 1° until it strikes the clamp *b* at *c*. Remove the clamp *b* and press C in its proper position, shown by D, which completes the forming of the ridge roll shown by 1 8 in Fig. 101.

In Fig. 106 is shown an O G gutter with beaded or wired edge on the outside. Obtain the girth of the gutter and bead the edge in the usual manner, after which place the sheet in the brake in the position shown by 1 8 in Fig. 107. Close the top clamp on dot 2 and make a square bend as shown by 1° 8. Now tip the bending leaf A in Fig. 108 as shown and place the sheet 1° 8 in Fig. 107 in the position shown by 1° 8 in Fig. 108. Then by gradually drawing out the sheet to dot 3 and closing the top clamp at each division between C and 3° the position 1°, *a*, *b* and C are obtained when the dot 3 reaches 3°.

Do not take out the sheet, but close the top clamp on dot 4, as shown in Fig. 109, by C 8, and make a square bend, bringing the sheet in position shown by A 8. Leaving the sheet in this position, as shown by A 8 in Fig. 110, fasten the former *a* by the clamp *b* and draw A in the position shown by B 8. When making this curve care should be taken not to pull down at *d*, for this would bring the upper curve *d* 3′ between 3′ and 4 in the direction of the arrow, until the vertical pressure at *i* completes the mold and 3′ touches the former at 3°. The rest of the bends shown by 5, 6 and 7 in Fig. 106 are bent in the usual manner.

When a half round gutter, shown in Fig. 111, is to be formed on the brake the method to be used is that shown in Figs. 112 to 115, inclusive. After the

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wired edge has been turned on the gutter shown in Fig. 111 place the sheet in position, as shown by A 3 in Fig. 112, and tipping the bending leaf slightly as was

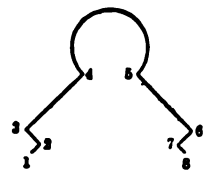

Fig. 101

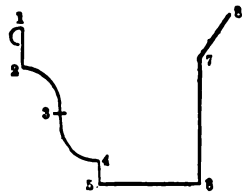

Fig. 106

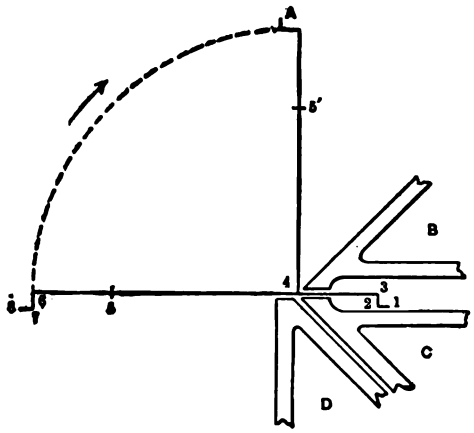

Fig. 102

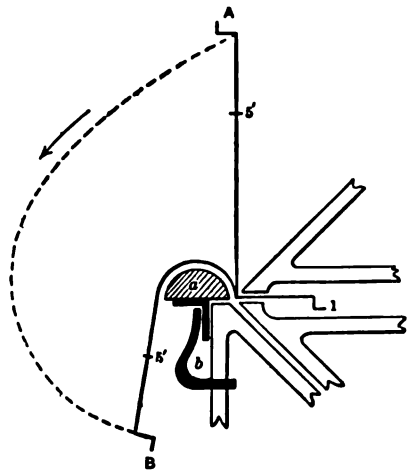

Fig. 103

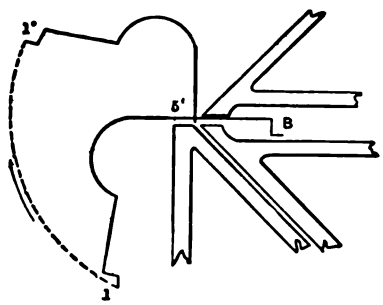

Fig. 104

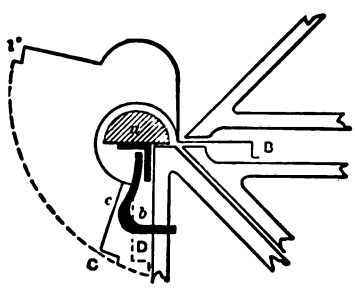

Fig. 105

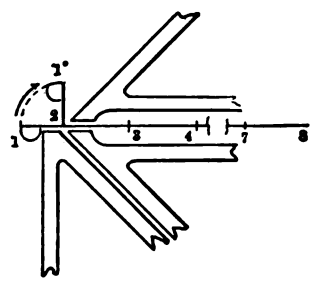

Fig. 107

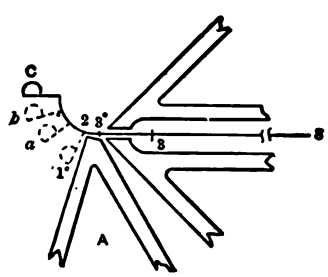

Fig. 108

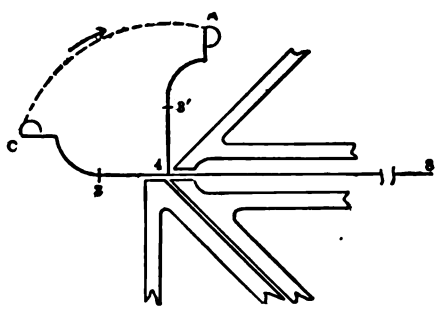

Fig. 109

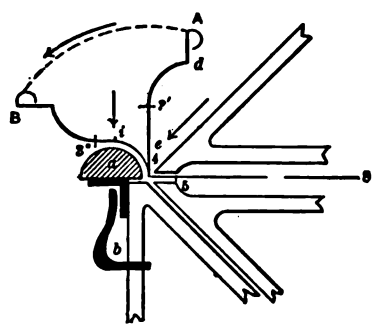

Fig. 110

Method of Forming Ridging and an Ogee Gutter

done at A in Fig. 108 obtain a slight curve to the front part of the gutter. Now reverse the sheet and place it in position, as shown by B 3 in Fig. 113, close the clamp on dot 2 and make a square bend, as shown by A 3.

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Leaving the sheet in this position, as shown by A 3 in Fig. 114, fasten the required size former *a* and draw A over the former until it has the position shown by B. The former should be smaller than the profile of the gutter, as the metal will spring back again after being drawn over the former. By referring to Fig. 111 it will be seen that the angle at 2 is not a square bend, and as a square bend

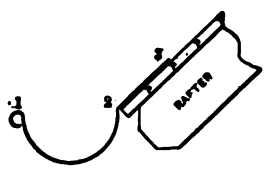

Fig. 111

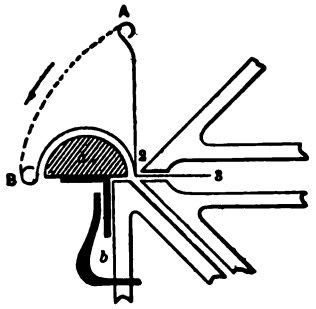

Fig. 114

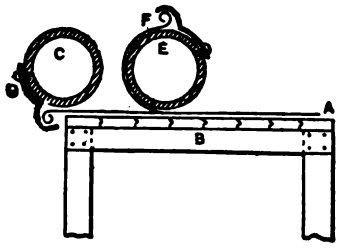

Fig. 117

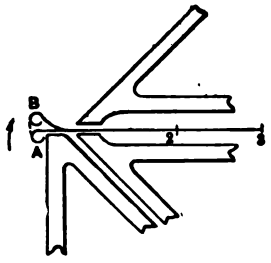

Fig. 112

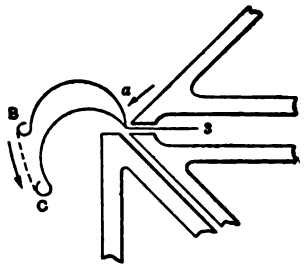

Fig. 115

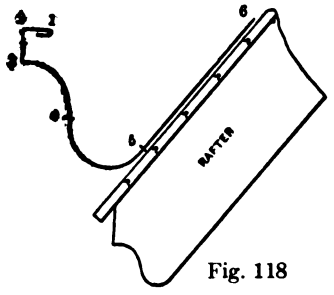

Fig. 118

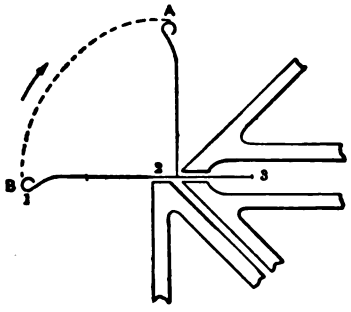

Fig. 113

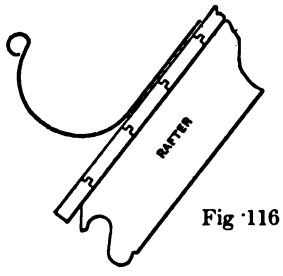

Fig 116

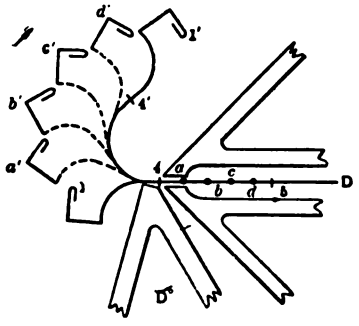

Fig. 119

Method of Forming Different Types of Gutters

is shown at 2 in Fig. 114, release the former so that the sheet will appear as shown in Fig. 115 by B. Then press it down in the position shown by C, or until it has the proper angle, being careful that the pressure is exerted at *a*. This completes the forming of Fig. 111.

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Fig. 116 shows another shape of gutter on which no bends are required. This shape could be formed in a manner indicated in Fig. 108, but a quicker and simpler way is shown in Fig. 117, which is also applicable to the gutter shown in Fig. 111.

First, bead the gutter in the usual manner and place it upon the bench B in Fig. 117, as shown by A. Now obtain an iron pipe or wooden roll, C, of the required size and length, being careful to have them a trifle smaller than the profile, because the metal will spring, and fasten—say, at distances of 3 feet apart—clamps as shown at D, the clamp to catch under the bead as shown. Now if two or three men (according to the thickness of metal used) spread their arms, grasp the pipe firmly and slowly roll it over until the desired position F is obtained the gutter will be finished so far as the forming of the roll is concerned. In this manner the form shown in Fig. 116 is obtained. If Fig. 117 were to be used for the form shown in Fig. 111 a bend would be made in the brake on dot 2, as shown by C 3 in Fig. 115.

Fig. 118 shows another form of O G roof gutter, the method of forming which is practically the same as that for the gutter shown in Fig. 106. The final processes, however, are shown in Fig. 119. Starting at dot 4, which corresponds to dot 4 in Fig. 118, space the distance between 4 and 5 in Fig. 119 into equal parts, as shown by *a b c d* 5. Draw out the sheet to dot *a* and slowly but firmly close the top clamp, when the gutter will have the position shown by *a'*; then draw out to dots *b c d* and 5, always closing the top clamp at each dot, when the gutter will appear, as shown respectively by *b' c' d'* and 1'. Then 1' D will be the desired shape to correspond to Fig. 118.

It should be understood that the higher the bending leaf D° is raised the closer the divisions are made between 4 and 5 and the tighter the top clamp is closed the smaller will the circle be, while if the bending leaf D° is tipped very slightly, the divisions between 4 and 5 being less in number, and the top clamp closed lightly, the larger will the circle be in the gutter. Experience and practice will show the various operations to use in bending the various size molds and curves.

PATTERNS FOR GUTTER MITERS ON ROOFS OF DIFFERENT PITCH

One roof is half pitch, as shown by A B C in the accompanying illustration, and the other is one-third pitch, as shown by A^1 J^2 I, Fig. 120. The shape of the gutter is shown by the profile M on the half pitch roof, and is the given profile.

For the benefit of readers who do not understand about roofs of one-half

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and one-third pitch we will explain how these pitches are determined. By a roof of one-half pitch it is understood that the vertical hight A J is equal to one-half the width of B C, while a roof of one-third pitch is understood to be one where the vertical hight is equal to one-third of its width.

The first step is to draw any line, as B C, which bisect, thus obtaining the point J. At right angles to B C and from J erect the line J A, equal to B J or J C. From A draw lines to B and C; then will A B C A represent a roof of one-half

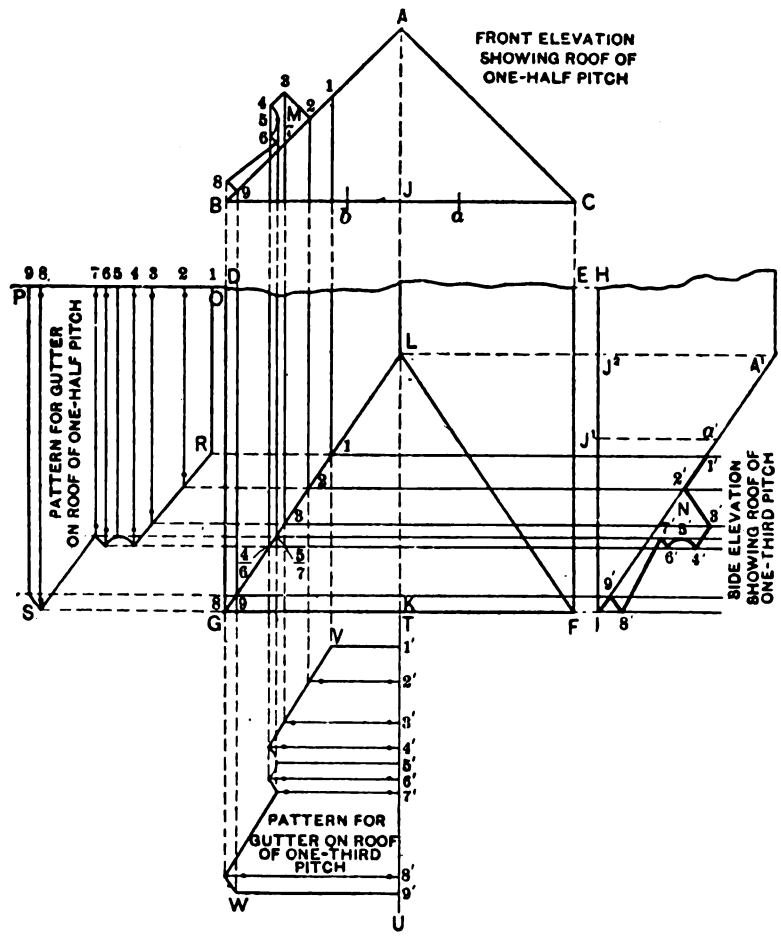

Fig. 120.—Gutter Miters on Roofs of Different Pitch

pitch. From the points B and C in elevation construct a plan, as shown by D E F G, and parallel to E F in plan draw the line H I, as shown. Transfer the distance from C to J in front elevation, placing it as shown from I to J^1 in side elevation, and divide the line C B into three equal spaces (for one-third pitch), as shown by *a b*. Take the distance of one of these spaces, as C *a*, and place it as shown by

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J^1 a' in side elevation, at right angles to J^1 I. Draw a line from I to a', extending it until it meets the line drawn at right angles to H I, equal in length to J A in front elevation, as shown by J^2 A^1 in side view. Then will J^2 A^1 I be the side elevation of a roof having one-third pitch.

From A^1, at right angles to H I, extend the line A^1 J^2 until it meets the center line A K in plan L. Draw a line from L to G and L to F, which will represent the roof plan of the two pitches. Let M be the given profile of the roof gutter placed upon the roof having one-half pitch, or it could be placed upon the roof of one-third pitch if desired. As the roofs are of different pitches, it will be necessary to obtain a modified profile on L K in plan, to admit the mitering at the hips L G and L F.

To obtain this modified profile, divide the profile M into equal spaces, as shown by the small figures 1 to 9. At right angles to B C and from these small figures drop lines intersecting the hip line L G in plan, as shown. From these intersections and parallel to G F draw lines indefinitely into the side elevation, as shown. Now, measuring in each and every instance from the line B C in front elevation, take the distances to points 1 to 9 in the profile M and place them on lines of similar numbers in side elevation, measuring in each and every instance from the line H I, thus obtaining the points shown from 1′ to 9′. A line traced through these points will be the modified profile through L K in plan.

For the pattern for the gutter on the half pitched roof, draw any line, as O P, at right angles to D G, upon which place the stretchout of the profile M, as shown by the small figures 1 to 9. At right angles to O P and through these small figures draw lines, which intersect with lines drawn from intersections having similar numbers on L G in plan, at right angles to D G. Trace a line through these points; then will O P R S be the pattern for the gutter on roof of half pitch, formed after the profile M.

For the pattern for gutter on the roof of one-third pitch, draw any line, as T U, at right angles to G F, upon which place the stretchout of the profile N, as shown by the small figures 1′ to 9′. At right angles to T U and through these small figures draw lines, which intersect with lines drawn from intersections having similar numbers on L G in plan, at right angles to G F. Trace a line through the points thus obtained, and T U V W will be the pattern for the gutter on the roof having one-third pitch, formed after the profile N.

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PATTERNS FOR THE MITERS OF A GUTTER MOLDING

The accompanying illustration, Fig. 121, shows how an inside and outside right angle miter can be obtained. Let A represent the profile of the gutter mold, placed upon the proper pitch of the roof, as shown. Divide the mold A into equal spaces, and place its girth upon the vertical line B C, through which horizontal lines are drawn and intersected by vertical lines dropped from similar numbered points in the mold A. A line traced through points thus obtained, as shown by D E, will be the miter cut, and E B C D will be the outside miter cut and E D G F the inside miter cut.

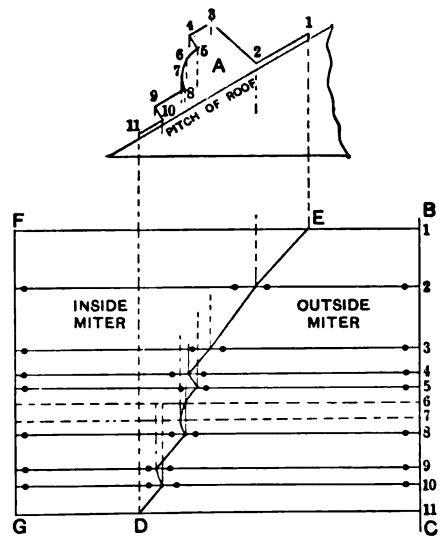

Fig. 121.—Obtaining Miters for Gutter Molding

The required pitch, so as to have water run to the outlet, would be made in the part numbered 1 2 3, and will necessitate but a slight change of procedure to obtain the miter cut of the pattern for that part.

PATTERN FOR EAVE TROUGH MITER AT ANY ANGLE

A simple way to lay out gutter of any size and cut the patterns for it, at any angle, is to lay out line A of any length, sufficient to give the width of the gutter desired, Fig. 122. About the center of this line set compasses with one leg on the line at B, and the other extended until it will mark the radius of the gutter. In this instance laying out a 5-inch half round gutter, so the compasses should be set to a radius of 2½ inches and a half circle struck.

Strike line C C parallel with A A and as far from it as half the diameter of the bead of the gutter will be. With 5-inch gutter the bead is generally ½ inch. Half of this is ¼ inch, therefore C C will be ¼ inch from A A and parallel with it.

Set the compasses to ¼ inch and move them along on line C C until the outer leg of the compasses touch the outer radius of the gutter, and with this as a starting point and D as a center, draw a circle for the bead of the gutter, and then add the tongue of the bead, which should be just the width that your beader slot will take.

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Parallel to line A A and at any convenient point lay out line E E about 11 or 12 inches long.

Beginning at the inner edge of the tongue of the gutter bead mark this edge No. 1, set the compasses with the leg on 1 and the other at the bend of the tongue, which will be called 2.

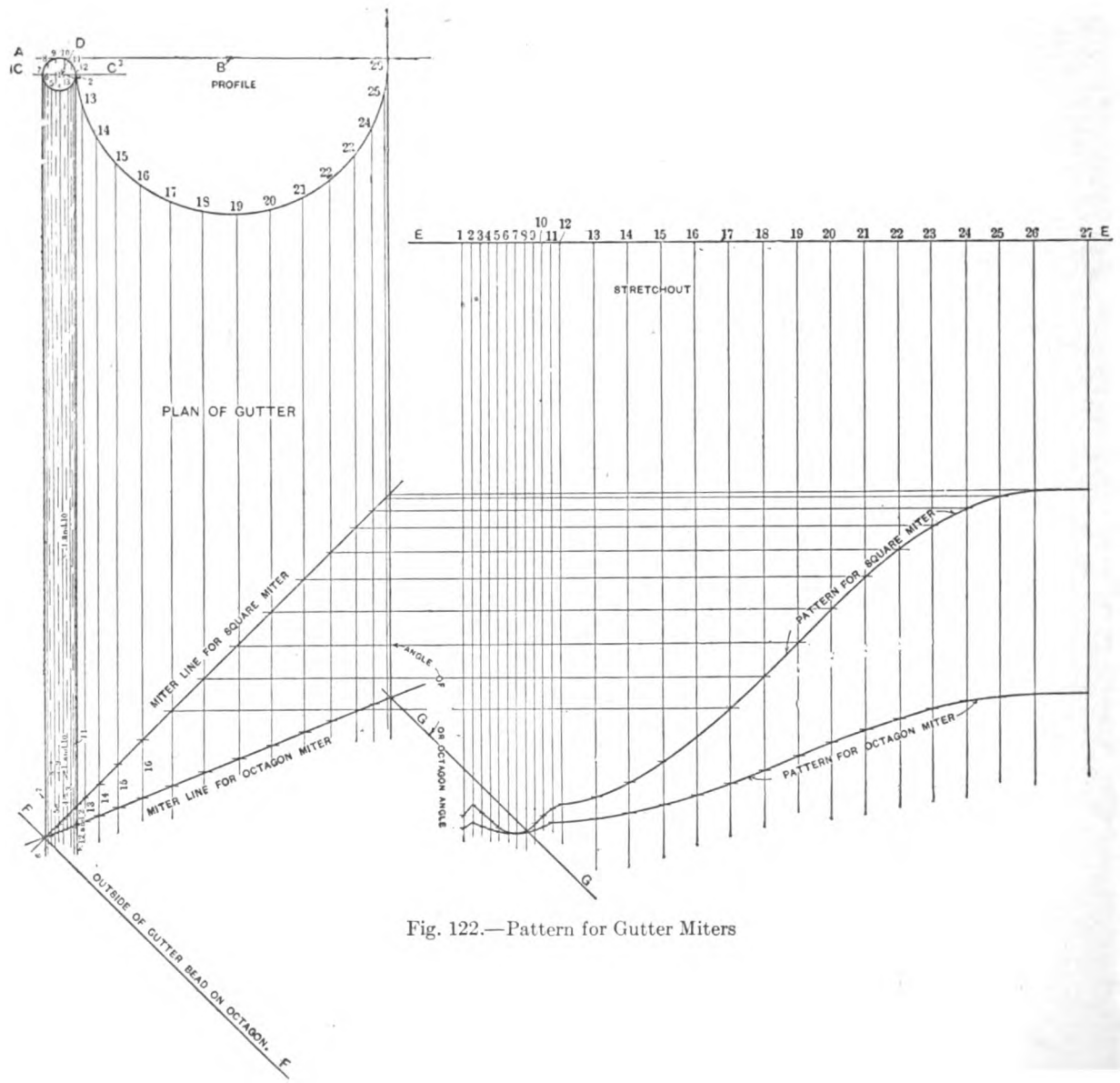

Fig. 122.—Pattern for Gutter Miters

With the compasses set as above, carry them over to line E E and set them down. Mark the two points made by the legs 1 and 2 the same as on the profile.

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Carry the compasses back to the profile, leaving them set as for 1 to 2, or set wider if desired to make the spaces longer, and successively set off 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12 on the bead, each of these distances being the same as from 2 to 3.

Mark off these spaces on line E E immediately following 1 and 2, already laid off, and number them successively from 3 to 12 as shown.

The spacing on the gutter proper need not be so close as on the bead, because the gutter does not change direction so sharply as the bead, therefore set the compasses for increased distances, as shown from 12 to 13, and proceed to divide the gutter up into equal spaces, as shown by 12 to 26, inclusive, and these spaces set off on line E E.

This leaves one space to be determined yet, and the stretchout is measured first so as to make the space 26 27 take up balance of required girth. If it is desired to make gutter out of 10-inch girth measure on stretchout 10 inches from 1 and mark same 27 on line E E of stretchout. Set the dividers so as to get the space from 26 to 27 and then mark this distance on profile from 26. This brings the back of the gutter in this case ¾ inch higher than the front, which is a good point as it will insure the water being thrown away from the building if the gutter ever overflows on account of the leaders being clogged or frozen, instead of overflowing on the rear edge and wetting the walls of the building.

In laying out the spaces on a stretchout it is not necessary, as many suppose, to make the spaces come out just even. Many starters at pattern cutting are perplexed by this and space off the profile time and again in an effort to make the last space come out the same as the others. The proper method is to lay out as many spaces as may be required for that surface and lay them all out the same distance except the last one.

These are stepped off on the stretchout, and then the dividers are changed to suit the last space, and it is stepped off and set down on the profile. It is only for convenience in laying out the work that the spaces in any curved surface, as from 12 to 26, are made the same. They could all be made different, but this would make more trouble in laying them out on the profile and on the stretchout, a this would require the dividers to be changed for each space. What is necessary is to space corresponding points exactly the same on the profile and on the stretchout.

Having done the spacing properly on both the stretchout and the profile and numbered all the points as they should be and as shown on accompanying sketch, take the square or T square, and from the points obtained and at right angles to A A and E E, draw lines indefinitely as shown. These lines drawn from

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the profile of the gutter give the plan of same, and a line drawn across this gutter with a 45-90 degree triangle will give the miter line for a square miter.

To get the angle for an octagon miter use the same triangle and draw line F F crossing line 7 of the plan. Parallel with line F F and exactly as far as from it as line 26 on the plan is from line 7, draw line G G. Where F F and G G intersect with lines 7 and 26 marks the beginning and end of the miter line for octagon miter, as shown on sketch. These two miter lines, marked "miter line for square miter" and "miter line for octagon miter," show in the plan just exactly the way the gutter would appear if it were cut off to a square or an octagon miter if we were looking down on it.

From the points where the lines in the plan cross the miter lines carry lines, at right angles to the plan, across lines of the corresponding numbers in the stretch-out, and a line traced through these intersections gives the correct pattern, to which should be added (on half the pieces cut) the edges, or laps, desired.

In the sketch the lines are carried across the stretchout to the corresponding lines in the stretchout, but it is not necessary, and is really confusing at times, to have so many lines, as all we really need to mark down are where the ines cross corresponding lines in the stretch out, as shown by the short lines crossing 1 to 16, inclusive. This method allows of cutting the pattern for any angle desired, and if the reader has no triangle he can get his miter lines by using a bevel set to the proper angle. For instance, with his bevel set for an octagon angle he can mark line F F, and parallel with it and at the exact distance from it that line 7 is from line 27 he can set off line G G, and where these intersect with lines 7 and 27 on the plan he traces his "miter line for octagon miter."

PATTERN FOR GUTTER MITER OR HIPPED ROOF

For the patterns for a roof gutter on a square hipped roof which has a one-fourth pitch, the gutter having a profile as shown by A B in the accompanying illustration, Fig. 123.

This miter should be developed the same as a return miter, and a mistake in problems of this nature, is often made in not placing the profile of the gutter in its proper position, as shown correctly in the sketch. The first step

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is to draw correctly the pitch of the roof. This is done by making *d c* equal to one-fourth of any line *a b*, or, in other words, the rise *c d* is equal to one-fourth the span *a b*. Then *a c* or *c b* represents a one-fourth pitch. Now draw the desired profile A B, which then divide into equal spaces, shown from 1 to 13. Draw the stretchout line C D at right angles to *a b*, upon which place the girth of the profile A B, as shown from 1′ to 13′. Draw the usual measuring lines, which intersect by lines drawn parallel to C D from similar numbers in the section. Then will C D E F be the desired pattern.

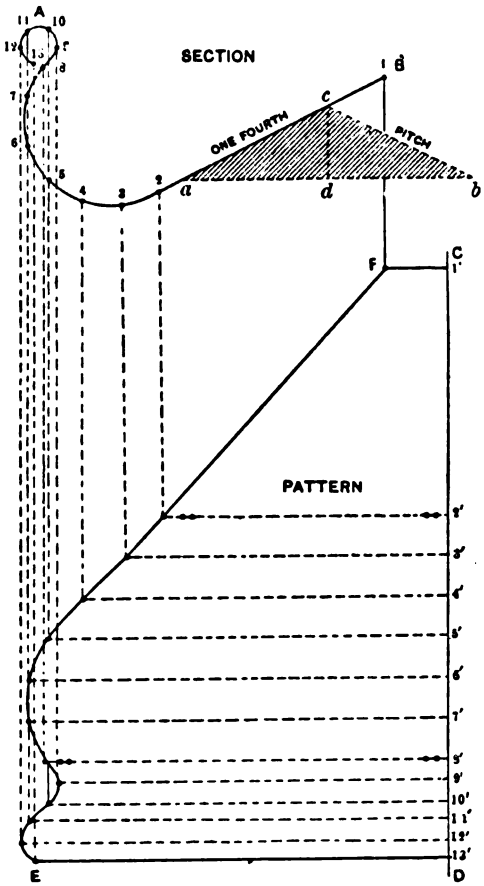

Fig. 123.—Pattern for Gutter Miter on Hipped Roof.

PATTERN AT ANY ANGLE FOR OGEE GUTTER

In the accompanying illustration Fig. 124, is shown the principle used in developing the pattern for a gutter at any desired angle. In this case the angle B C D has been made 45 degrees, but the same principle is used, no matter what degree the angle may have. First draw the profile of the gutter, shown by A, which divide into equal spaces, shown from 1 to 11. Place the desired angle B C D in line with 2 3 of the profile, as shown. Having the angle in its proper position the next step is to obtain the miter line C *c*. This is done by using C as center, and with any radius describe an arc intersecting B C D at *a* and *b*. Using *a* and *b* as centers, with the same or any other radius describe arcs intersecting each other at *c*. Draw the line C *c*, which is the miter line desired.

From the various points 1 to 11 in A drop vertical lines intersecting the miter line C *c* from 1 to 11. At right angles to B C draw the line B E, upon which place the girth of A, as shown from 1 to 11, from which at right angles to E B draw lines, which intersect by lines drawn parallel to E B from various intersections on C *c*,

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resulting in the intersections shown. A line traced through the points thus obtained, as shown by F H, will be the desired miter cut. As the wall line is shown

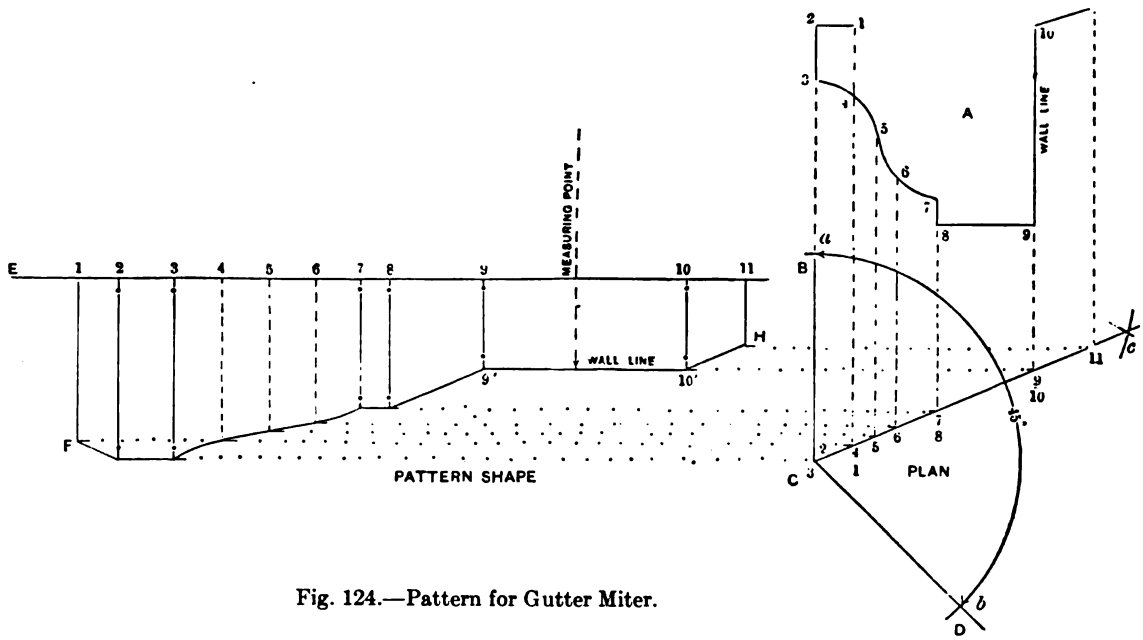

Fig. 124.—Pattern for Gutter Miter.

from 9 to 10 in A then will 9′ 10′ in pattern be the line from which measurements are made.

PATTERN FOR RAKING EAVE TROUGHS

To get the miter patterns where the horizontal half round eave troughs A B and C D in Fig. 125 join the raking trough, proceed as follows:

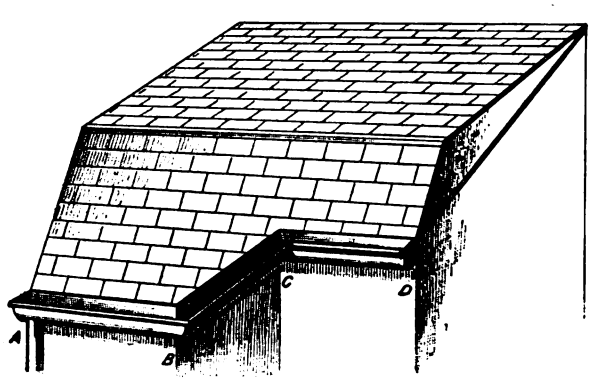

Fig. 125.—Perspective of the Eave Troughs.

In Fig. 126 draw the plan A B C D, showing the angles of the wall, and above the same draw the side elevation A^1 B^1 C^1 D^1, in which 12 H represents the pitch of the roof and E and E^1 the given profiles of the horizontal eave troughs at bottom and top, respectively. As the inside cut of the miter B in Fig. 125 will answer for the miter C, it is necessary only to obtain the pattern for the lower miter, B.

Divide the trough E in Fig. 126 into parts as shown from 1 to 12, allowing

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a flange, 12 13, on roof. Through 12 draw the horizontal line F G, and from any convenient point, as F, erect F H, intersecting the pitch of the roof at H. Bisect angles A B C and B C D in plan as shown, and draw the miter lines *f* 3 and C *c*. Through the points in E draw vertical, lines, cutting G. F and *f* 3, as shown, and at pleasure draw the horizontal line K L.

For the miter patterns for the horizontal troughs at B and C in Fig. 125, draw any horizontal line, as K L in Fig. 127, upon which place the stretchout of the profile E in Fig. 126, and draw the vertical lines in Fig. 127, as shown. Now, measuring in each instance from K L in Fig. 126, take the various distances to points 1 to 13 on the miter line 13 3 and place them on similar numbered lines in Fig. 127, also measuring in each case from K L; Through points thus obtained, trace the miter cut C D. Then will 1 C D 13 be the pattern for the horizontal trough A B, and C F E D in Fig. 127 the pattern for the horizontal trough C D.

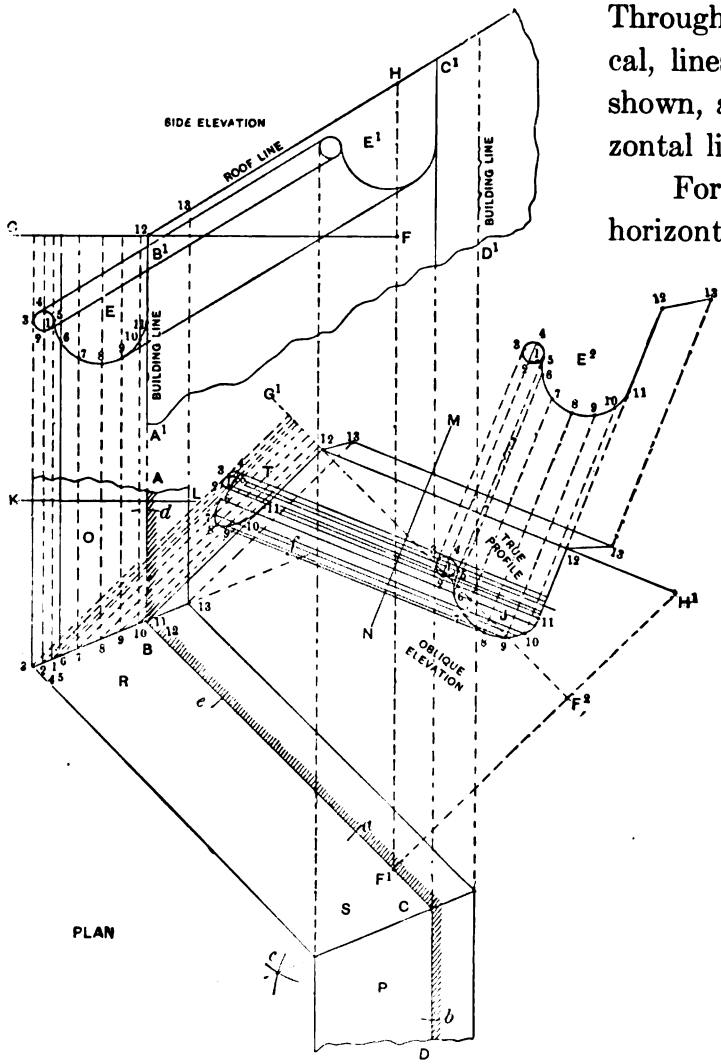

Fig. 126.—Drawing of Projections.

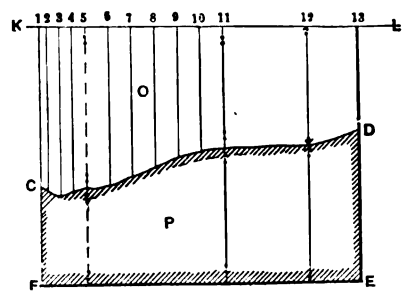

Fig. 127.—Patterns for Horizontal Gutters.

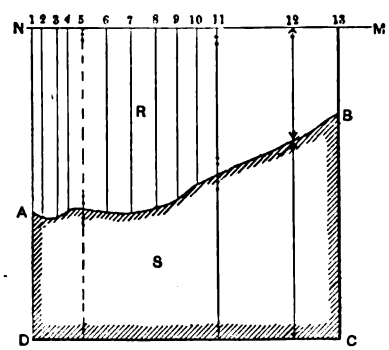

Fig. 128.—Patterns for Raking Gutter.

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Before obtaining the pattern for the raking trough an oblique elevation and true profile through same must be obtained. Parallel to B C in plan in Fig. 126, draw G^1 F^2, perpendicular to which and from 12 in plan erect a line, intersecting G^1 F^2 at 12. Extend the line H F until it cuts the wall line B C in plan at F^1, and from F^1, perpendicular to B C, erect a line, intersecting G^1 F^2 at F^2. Extend it so that F^2 H^1 will equal F H in side elevation. Draw H^1 12, which is the true pitch of the roof on B F^1 in plan. From the various intersections on 13 3, at right angles to B C, erect lines meeting G^1 F^2, as shown. Then, measuring in each instance from the line G F, take the various distances in the profile E from 1 to 13 and place them on similar numbered lines drawn from the miter line in plan, measuring in every case from the line G^1 F^2, resulting in the intersections shown from 1 to 13 in the oblique elevation, from which points draw lines indefinitely parallel to 12 H^1, as shown. Take a tracing of the profile E, with the various intersections on same, and place it at right angles to 12 H^1, as shown by E^2, from which, at right angles to 12 H^1, draw lines intersecting those previously drawn. Trace a line through points thus obtained, when J will be the true profile of the raking trough. Knowing this, the pattern can now be obtained.

At pleasure draw the perpendicular M N. Draw also M N in Fig. 128, upon which place the stretchout of the profile J in Fig. 126, being careful to measure each and every space separately, as they are all unequal. From these divisions in Fig. 128, perpendicular to M N, draw lines shown. Measuring from the line M N in Fig. 126, take the various lengths to the various points in the miter line T and place them on corresponding lines in Fig. 128, measuring from the line M N. A line traced through points thus obtained is shown by A B. Then will 1 A B 13 be the miter pattern for the lower corner of the raking trough, shown by B in Fig. 125, and A B C D in Fig. 128, the miter pattern for the upper inside corner shown by C in Fig. 125. The horizontal troughs are to be formed after the profile E in Fig. 126, while the raking trough is formed after the profile J in the oblique elevation.

BEST MATERIAL FOR LINING GUTTER

It is the consensus of opinion that the best material for gutter lining is in the order named: soft copper, lead, tin and galvanized iron. Zinc is but little used

It is agreed that copper if properly laid to allow for expansion and contraction is the most durable material. The objection to lead is that while the metal

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itself will last, it creeps when expanding and contracting, and this moving of the metal causes buckles which eventually crack; and the metal tears very easily. Copper is most always specified on high-grade jobs. For ordinary jobs a good tin plate, if carefully applied, will make a substantial gutter. This is a much-mooted question, having been discussd periodically in the columns of the *Metal Worker* with no apparent results, for the query still comes up.

It must be remembered that a roof receives harder usage than any other part of a structure, especially the gutter—in summer the terrific heat of the sun and then a cool night, with perhaps a shower that is virtually a deluge; in winter extreme cold, snow, ice and sleet; storms that would pierce armor plate. Is it to be wondered that the material succumbs to the strain? If we buy a pair of the best shoes and wear them continually over rough pavement, through mud, snow or water, we expect that very shortly we must discard them; so why look for the impossible and demand that gutter linings last forever? Realize the aforesaid and when you line a gutter do it in the best known manner and give a reasonable guarantee and when the inevitable occurs let the house owner admit that his shoes are worn out and need repairing or replacing—that is, his gutter lining does.

LINING A LARGE GUTTER WITH COPPER—I

It is suggested that 20 ounces cold rolled copper be used to line a gutter like Fig. 129 so as to allow for expansion and contraction. It should not be calked direct to stone coping but as indicated. The lining should be laid as shown in the illustration, Fig. 129, to allow for expansion and contraction. The entire lining is free to work with this method. First a ledge indicated by *a* should be calked into the stone coping, having an outward bent flange at the top, to which the gutter lining is hooked as shown at *b*. The lining is bent in a manner as shown, with a lock attached at *c*, which goes under the tiling. This lock is fastened to the sheathing by means of cleats indicated by d and fastened or nailed at e.

In lining the gutter use sheets 72 x 36 inches wide, as the gutter is some 5 feet wide, tinning the edges of the cross seams 1½ inches on both sides and thoroughly sweating the joint with half-and-half solder, using 8 or 10 pounds soldering coppers and rosin as a flux.

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At the highest points of the gutter expansion joints should be used as indicated in the illustration, in which A A shows the wood or concrete base over which the lining is laid. At the highest point of the gutter, instead of continuing the lining, a space of about ½ inch is provided as indicated by f and two heads soldered to the lining as indicated by B, with outward flanges as shown. Over these two flanges the cap C is slipped. This allows the metal to expand and contract.

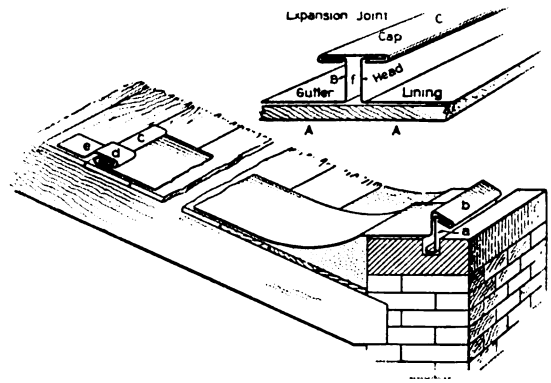

Fig. 129.—Allowing for Expansion in a Gutter

Thus by having expansion joints at the highest points of the gutter and the front edge hooked at b and cleated at d the entire lining has not a single nail in it and is free to expand or contract. The front ledge at b also prevents any water from running over the front edge of the coping, which is an annoyance in winter weather when the sun thaws the ice on the coping, which drops and freezes below in the shade.

LINING GUTTERS WITH COPPER—II

The following method is suggested for a gutter 75 feet long and of a width that takes 84 inches of copper. Under no consideration should the copper lining be nailed to the sheathing. When the walls at the side and two ends, shown by A in Fig. 130, are carried up as far as D, build in a cap flashing as there shown. The carpenter should then line out the gutter or valley with smooth sheathing warranted not to shrink, as shown by B and C, being careful to have a good pitch toward the leaders. The copper lining E is then put in position, slipping one end under the cap flashing D, and the other on the roof and have the slates so laid as to cover the copper about 6 inches. The copper to be fastened here by cleats as shown by G and H, and use copper 36 inches wide so as to have as few seams as possible. Where the cross seams occur the sheets should be thoroughly tinned 2 inches wide on both sides and a lock

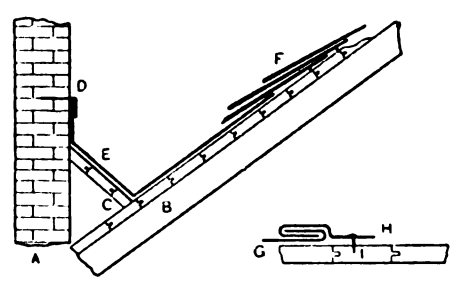

Fig. 130

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placed thereon and fastened with cleats, as shown in the illustration, where G represents the sheets fastened by the cleat H, and nailed to the sheathing at I. In no case should the sheet be nailed directly to the wood lining, because the expansion and contraction of the metal would cause the copper to tear out at the nail. By using cleats the copper has a chance to expand with the heat of the sun and contract with the cold, the portions under the cap flashing and slate being entirely free. When the locked seams are thoroughly closed with the mallet use heavy coppers and thoroughly soak the seams with half and half solder, raising the cap flashing slightly to allow the soldering of the upright seam. Then lay a smooth board about 6 × 12 inches over the cap flashing and dress down well with the mallet.

REPAIRING BURST SEAMS

Thoroughly soak the seams with solder then over the seams solder a strip of copper which has been tinned, and of course where the edges of this strip is soldered to gutter tin that part of gutter then thoroughly sweat the solder in, going over two or three times and on the upright part of gutter reinforce the soldering by placing heavy stitches of solder close together.

LEADERS, GUTTER LINING AND COPPER ROOFING ON CONCRETE BASE

In the following illustrations are shown the methods employed in laying the copper gutters and roofing on a job in New York City. In Fig. 131 is shown the section and elevation of the gutter and leader and in Fig. 132 the plan of the soffit. It will be seen that the entire framing is of iron, with the brackets of wrought iron.

In Fig. 131 A is a sectional view, in which the arch D is of enameled brick, as shown in the view of the soffit in Fig. 132 by D^1. Over this arch in A in Fig. 131 is concrete D E, given the required surface pitch to the outlets. On the concrete is the gutter lining, this locking into the angle iron B. The roofing connects to the gutter by means of the mold C.

In the elevation F shows the leader head placed under the outlet tube of the gutter at V, the leader head F being connected to the lower head J by means of the gooseneck H. The main leader head J is then connected to the leader L,

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which is held in position by the cast iron fasteners N, secured in turn to the stonework P by means of expansion bolts. The leader projects from the wall the distance indicated by N^1 on the plan Fig. 132, while F^1 and J^1 represent respectively

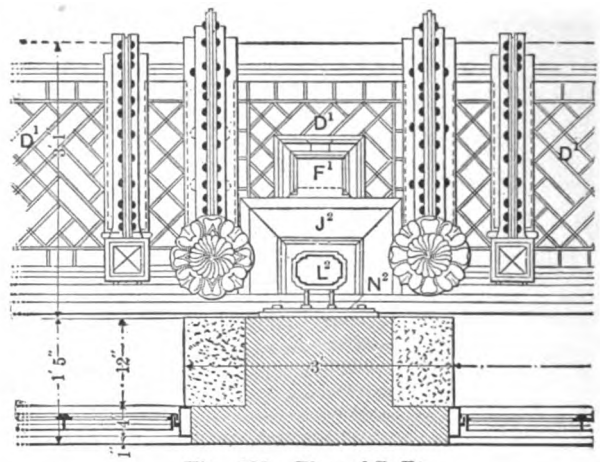

Fig. 132—Plan of Soffit

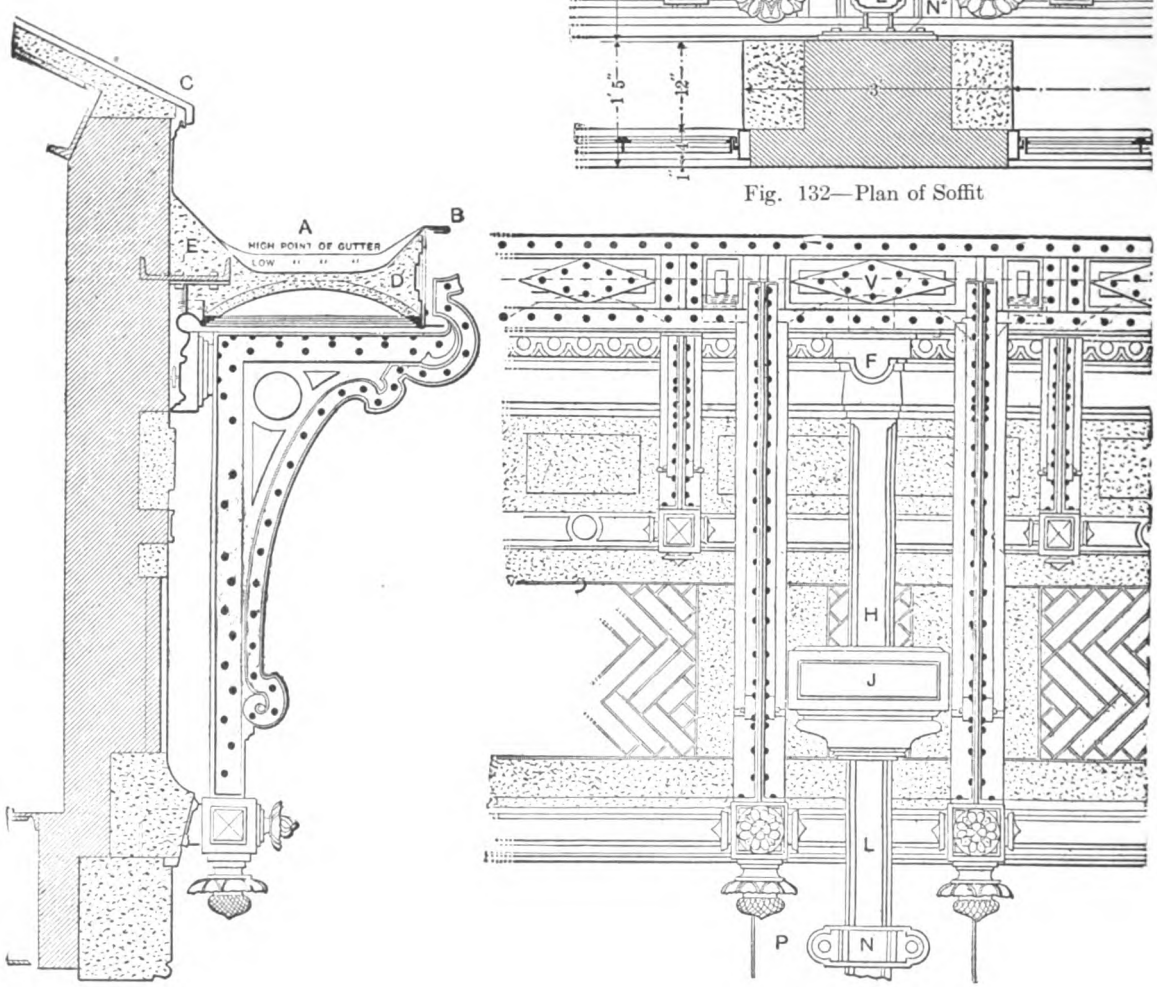

Fig. 131 —Section and Elevation of the Gutter and Leader

the soffits of the heads shown in Fig. 131 by F and J. The amount of the compound curve in the gooseneck H is indicated in Fig. 132 from F^1 to L^1.

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The method used in laying the roofing and lining to overcome defects caused by expansion and contraction of the metal is shown in connection with Figs. 133 and 134. In Fig. 133 the construction of the gutter lining is indicated and also the method of securing the molding at the eave of the roof without nailing, but by the use of cleats. A is the brick wall, B the concrete gutter lining and C the concrete roof. E is the gutter lining, laid into the concrete gutter and locked into the angle iron at F and flashing up under the concrete roof at H. The angle iron at the front edge at F is secured to the ironwork as shown in Fig. 131.

Before the copper lining E is laid the cleats D and N are riveted to the gutter as shown and the rivet heads soaked with solder to avoid leaks, care being taken to obtain the correct location of the cleats so that when the molding J is placed on the eave of the roof the hem edged flange O will rest into the hook on the cleat, which is then closed with the mallet as at N. Note the drips formed on the molding at X and X. The upper flange of the molding J has a lock attached which is cleated to the roof L at M. Thus it will be seen that the entire lining and eave mold have no nails driven into the metal, thus allowing it to expand and contract freely. The cross seams in the gutter are first tinned, then edged, cleated and locked, thoroughly soaking the seam with solder, using rosin as a flux.

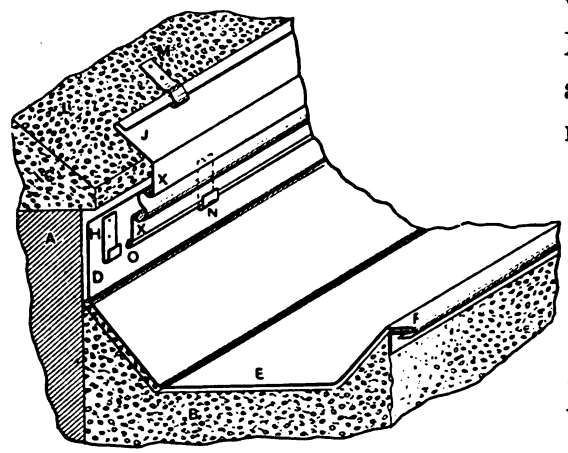

Fig. 133.—Construction of Copper Gutter

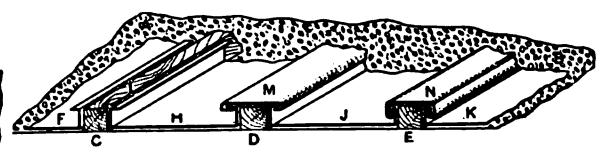

Fig. 134.—Construction of Copper Roofing

The roofing was constructed as indicated in Fig. 134, in which A B is the concrete roof. Wooden strips shown by C, D and E are nailed at given distances. Knowing this distance and the hight of the strip the copper sheets are bent on the brake in long lengths, tinning and edging the ends of the sheets, so that the cross seams can be locked. Assuming that this has been done, the sheets are laid in position as indicated by F, H J and K. The first operation is shown at L. The cap M is then slipped on and the locks are then closed and turned down in the position shown by N. In this way the sheets have room for expansion and contraction, the entire roof being free from nails excepting where the cleat is nailed

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to the roof at the cross seams in F, H, J and K in the manner indicated in M of Fig. 133. At the ridge of the roof the sheets are double locked, as in standing seam roofing.

MAKING AND ERECTING THE CORNICE, GUTTERS, ETC., FOR A BUILDING AT A DISTANT POINT

There was erected a large building, for the joint use of a railroad as a terminal station and of the government as a custom house. It was made absolutely fireproof

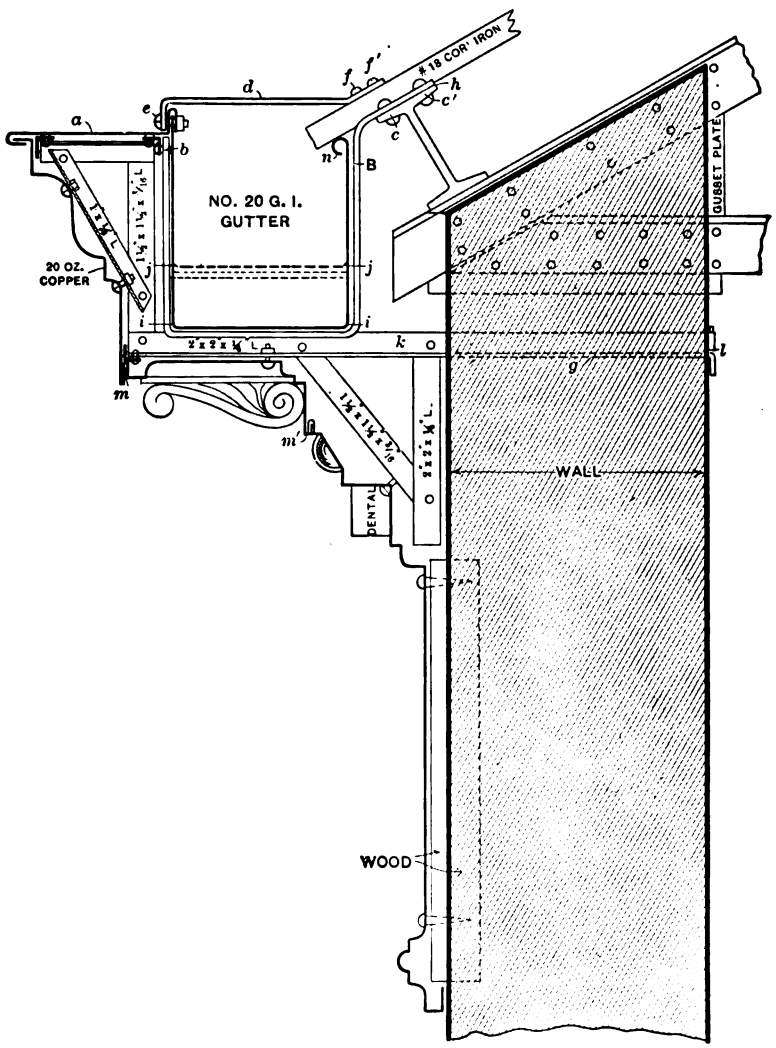

Fig. 135. Section at the eaves.

throughout, no combustible material being used. The main building was two stories in hight and about 130 feet square, with a 40-foot square court surrounded

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by a promenade covered with special steel frame skylight construction. The train shed was the width of the main building plus 20-foot awning on each side and 760 feet long The roof of the train shed was constructed with three monitor ridges making two valley gutters, besides the eave gutters on the sides and awning gutters.

On the train shed there was approximately 2000 feet of awning gutter and something like 1500 feet each of eave and valley gutter, all made of No. 20 galvanized iron supported in wrought iron hangers and drained by wrought iron pipe conductors connected with the gutter by brass fittings. On the main building there was about 500 feet of main cornice of 20-ounce copper, 160 feet of

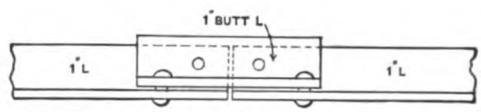

Fig. 137 —Angle Iron Joint

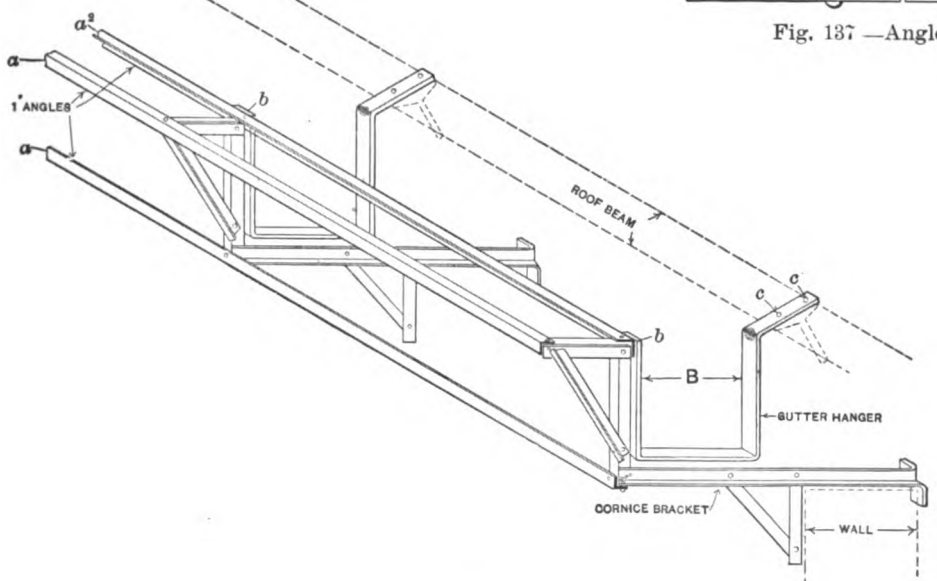

Fig. 136.—Wrought Iron Brackets and Hangers

copper court cornice, 1800 square feet of special skylight, 1000 feet of copper cresting, a number of large copper ventilators, two flagstaffs with fancy copper bases and several elaborate copper finials. Described in Book 4.

The metal work was done by a concern which made it all complete ready for erecting, so that nothing remained to be done at the building but to put up the sections of cornice, gutters, etc. A man was sent from the shop to do the work with local help. It will be seen from this that the planning and execution of the work in the shop must have been well-nigh perfect, as it all went up without the least hitch.

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Fig. 135 shows the building construction at the eave, where the main cornice was attached, and a cross section of the main cornice and gutter; also a side view of the wrought iron supporting brackets and hangers. Fig. 136 is a detail showing the cornice brackets and gutter hangers alone. One-inch angles, a a^1 and a^2, run continuous, the brackets being spaced about 3 feet 6 inches apart. Fig. 137 shows how the joints were made in a a^1 and a^2. B is the gutter hanger, which was made of $\frac{3}{8} \times 1\frac{1}{2}$ inches bar iron. The hangers were riveted to angle a^2 at b and to the roof beams at c and c^1. The brackets were all alike, as the cornice was horizontal, but the gutter was made with a fall, each shed being about 20 feet long. Hangers B were therefore made of different depths, as indicated by the dotted lines, Fig. 135, the width, of course, remaining the same.

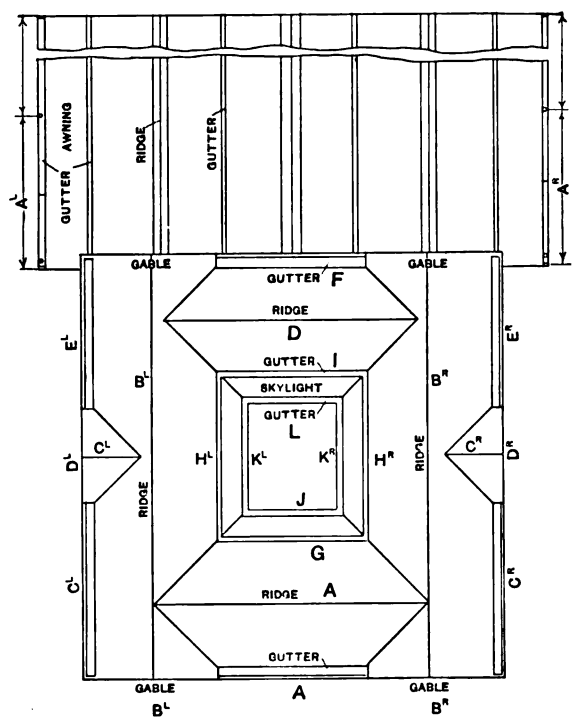

Fig. 140.—Plan of Skylight, Gutters, etc.

The main cornice was about 3 feet high and had stamped modillions and egg-and-dart and dentil courses. The work was planned so that the brackets were built in the wall by the masons. Next the gutter hangers were put in place and riveted, next the cornice then the gutter, and lastly the copper connecting piece, a, Fig. 135.

It will thus be seen that both cornice and gutter were accessible on both sides, which allowed of riveting the seams when being put up. After a was put on, dogs, d, made of $\frac{1}{8} \times 1\frac{1}{2}$ inches galvanized strap iron, were riveted to the standing edge e through a and the gutter and to the No. 18 corrugated iron roofing by two rivets at f and f^1. No expansion joints were made in the gutter, as it lay loosely in the hangers and was not sufficiently attached to anything to prevent free expansion and contraction.

The method of laying out the gutter was as follows: An elevation of a line of gutter was made to a $1\frac{1}{2}$ inch scale horizontally, as indicated in Fig. 138, showing the highest points, a and a^1, and the lowest point, b. Horizontal line, j j, Fig.

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139, was then drawn to represent the highest point in the bottom of the gutter. From *b*, Fig. 138, a line was dropped across *j j*, Fig. 139, and *k* established 3 inches below it, which was the actual fall of the gutter, and lines *i k* and *k i* drawn, showing the slope. Seams *c*, *d*, *e*, *f* and *g*, Fig. 138, and centers of hangers, 1, 2, 3,

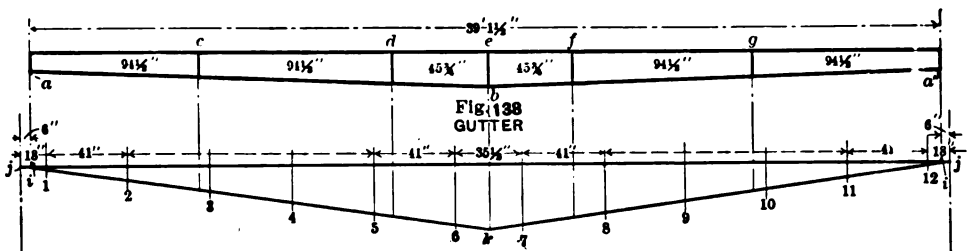

Fig. 139.—Spacing of Hangers and Fall of Gutter and Hangers

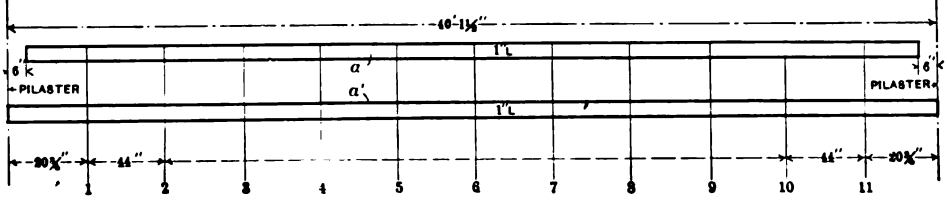

Fig. 141.—Cornice Bracket Spacing

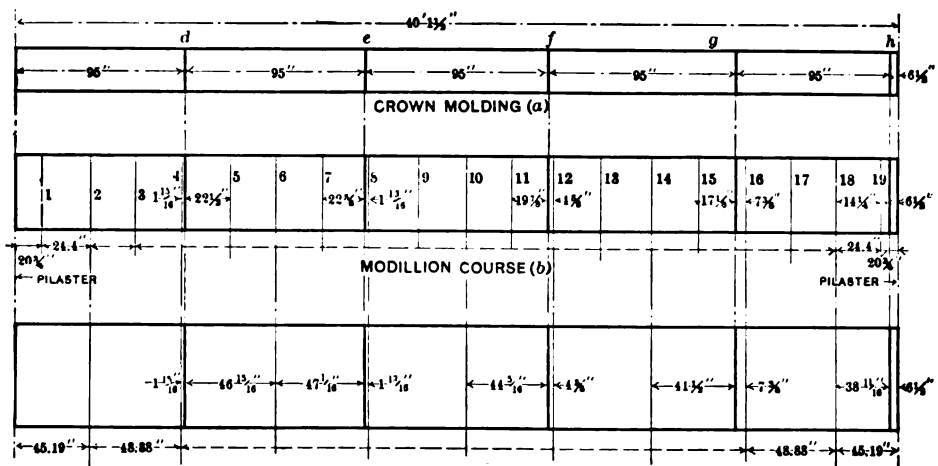

Fig. 142.—E & D, Dentil & Frieze Course (*c*)

etc., Fig. 139, was then spaced exactly to scale horizontally and lines drawn from them across *j j* and *i k i*, Fig. 139, as shown. The construction of the gutter and hangers above *j j* did not vary, see Fig. 135.

Center lines, 1, 2, 3, etc., being spaced horizontally exactly to scale, and *j j* and *k* being spaced vertically full size, the difference in the length of 1, 2, 3, etc.,

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between lines *j j* and *i k i* was the actual difference to be made in the drop of the different hangers, and the difference in length of lines *c, d, e, f* and *g* between these lines was the difference in the ends of the 8 feet and shorter lengths of gutter.

All the hangers were numbered in consecutive order, and to show where the numbers belonged a small plan of the building was made, as indicated in Fig. 140, and the different stretches of main cornice and gutter lettered A, B, C, D, etc., thereon. A separate layout was made of each line of gutter, as in Figs. 138 and 139, which represent line A, Fig. 140. The gutter was got out by these layouts and each piece marked accordingly. The work was put together in the shop in 16-foot lengths, and strictly in accordance with the layouts.

As angles *a*, a^1 and a^2, Fig. 136, run continuously, and the lines of cornice vary in length somewhat, which varied the spacing of the brackets, a layout of each line of bracketing and cornice was made, showing the spacing and locating the rivet holes to be punched in angles *a*, a^1 and a^2. The layout is indicated in Fig. 141, which represents line of cornice A, Fig. 140.

Lines 1, 2, 3, etc., Fig. 141, represent the center of rivet holes in brackets through which angles *a*, a^1 and a^2 are riveted. Wood pieces were built in the wall, to which the lower part of the cornice could be secured by brass screws, and when the walls were completed up to the point *g*, Fig. 135, the brackets were placed in position and angles *a*, a^1 and a^2 riveted thereto—which took care of the spacing of the brackets—after which the wall was continued up and the roof structure placed thereon. The holes in beam *h* for receiving the gutter hanger rivets were punched by the sheet metal man with a heavy screw punch. The holes in angle a^2 and gutter hanger, at *b*, were, of course, punched in the shop. The 2-inch bracket angle *k* was made long enough to extend through the wall about 2 inches and had its inner end split and the flanges turned as indicated at *l*, which firmly secured it against being pulled out by the weight of the cornice and gutter, the weight having that tendency.

Fig. 135 shows seams in the cornice at the points *m* and m^1, which divided it into three sections of courses and facilitated the work of assembling. A layout of each course was made as indicated in Fig. 142. Course (*a*) represents the crown molding section; course (*b*) the soffit section, and (*c*) the egg-and-dart, dentil and frieze section. Ornaments were placed on the frieze under every alternate modillion. The vertical lines designated by letters indicate the seams in the cornice, and those designated by figures at course (*b*) the center of modillions and those at course (*c*) the center of ornaments.

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It was, of course, necessary to carefully develop and figure all these layouts before any actual work was done in the shop. After all the layouts were made they were traced and blue printed and all the work in the shop and at the building was done from the same drawings and data. A complete copy of all data was sent to the builders. Thus every one connected with the work thoroughly understood and was governed by the same plans. All numbering and lettering on the gutter hangers and other wrought iron work was done by means of steel die stencils, which stamped the number into the metal. This was necessary, as the work was painted in the shop and again at the building before being put up, and any marking that depended upon color was therefore useless.

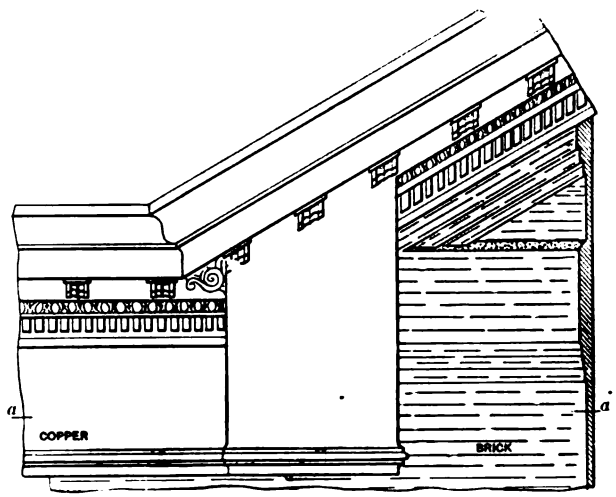

Fig. 143. Level and Gable Cornice Miter.

Fig. 143 shows the junction of the main level cornice with the main gable cornice on the front of the building, and it will be seen that the gable modillions, dentils and egg-and-dart molding, as well as the cornice, were raked. Fig. 144 is a section on *a-a* of Fig. 143 looking upward. The main gable cornice is the same as the main level cornice, except that the frieze and foot molding has been left off; the brickwork of the gables between pilasters being corbeled out in such a manner as to take the place of the frieze, this junction between level and gable cornices being novel. The gable cornice was laid out in the same manner as the level cornice.

Fig. 145 is a cross section through the gable cornice showing the junction with the corrugated iron roofing, and the method of securing the wrought iron brackets. It will be seen that the roof beams *a* overhang the wall and are faced on the ends with a channel bar *b* the same depth of the beams. The top horizontal angle *c* of the cornice brackets was made longer than for the level cornice and riveted to the top flange of the channel. The front vertical angle *d* of the brackets is secured to the bottom flange of the channel by a short piece of angle *e* riveted to both as shown. The 2-inch bracket angle *f*, instead of extending through the wall as for the level cornice, was cut off so as to project into the wall about 3 inches, and holes were chiseled in the brickwork after it was built to

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receive the ends of the angles. Continuous 1-inch angles, a a^1, were used in the gable brackets, but a^2, Fig. 136, was omitted because of the connection to the flange of the channel bar.

The cornice moldings were gotten out in the usual manner, except as to a few points. Fig. 142, shows the spacing of the modillions and frieze ornaments as related to the seams in the cornice. Therefore, in getting out the 8-inch sheets or sections of modillion and frieze courses, after the laps were allowed, the distance from the seams to the nearest modillion or ornament was measured off and two prick marks made side by side in an imaginary line across the cornice indicating the center of modillion or ornament. In the modillion courses these prick

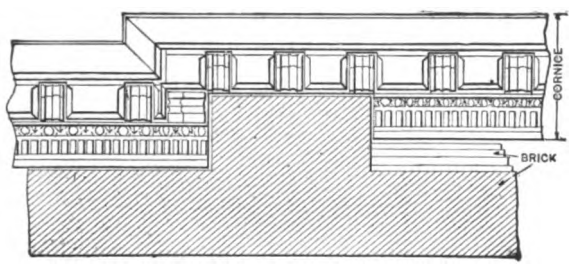

Fig. 144. Soffit Plan of Cornice.

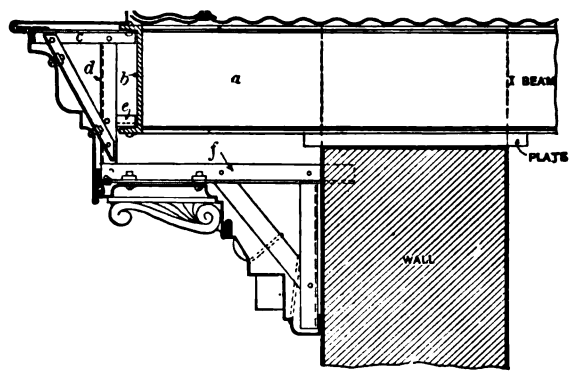

Fig. 145. Section of Gable Cornice.

marks were made at the point a, Fig. 146, and when the sheet was cut and pricked ready for bending, it looked like Fig. 147, the prick marks b showing the center of modillions.

The face and sides of the modillions were stamped, but the bed moldings were made of plain crimped copper (all the copperwork was crimped) and connected to the stamped portion of the modillion in the usual manner, as indicated in Figs. 148 and 149, which shows a section on a-a and b-b, respectively, of Fig. 150, the latter being a perspective view of a modillion in place on the cornice. Fig. 151 is a pattern of c, Figs. 149 and 150. The prick mark d, Fig. 151, was made in the pattern and pricked lightly into each piece, so that when the modillion was formed ready to place on the cornice, prick mark d showed as indicated at d^1, Fig. 150. This saved the time and possible inaccuracy incident to measuring or guessing the centers of the modillions when attaching them to the cornice. It requires much less time and is far more accurate to prick the modillion courses and moldings than to do the measuring necessary to spacing after the cornice and modillions

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are completed. Proper allowance was, of course, made on each end of the crown molding course for the miters at the junction between the level and the gable cornices.

Figs. 138 and 139 represent the layout of one line of the main cornice gutter. After this layout was completed the work of getting out the gutter and hangers was proceeded with as follows: For convenience the profile of the gutter was traced from the full size detail represented by Fig. 135, as indicated by Fig. 152. The solid line, of course, showing the lowest point of the gutter and the dotted line J J the highest point. Next, lines a-a^1, b-b^1, Fig. 153, were drawn parallel to each other and spaced the width of the gutter apart; then the line $o\ o^1$ was drawn perpendicularly across these two lines; then lines $c\ c^1$, $d\ d^1$, $e\ e^1$, were drawn parallel to $o\ o^1$ and represented the seams in the gutter. These seams lines were spaced exactly to 1½-in. scale from $o\ o^1$. Then the full size stretchout of the shallowest part of the gutter was laid out on $o\ o^1$, and the stretchout of the deepest point of the gutter on $e\ e^1$ and the lines $o\ e$ and $o^1\ e^1$ drawn, cutting the intermediate seam lines which established the stretchout of the ends of the three different pieces of gutter.

As the material was of No. 20 gauge, it was necessary to make proper allowance in the stretchouts, so that the end of one piece would lie in the end of the next piece. Fig. 154 is a side view showing a lap joint in the gutter, and Fig. 155 is a section on $a\ a$ of Fig. 154. It will be seen that the stretchout of inside end A, Fig. 155, must contain less material than outside end B. In Fig. 153 $c\ c^1$ is the stretchout of B, and $c^2\ c^3$ that of A. It will be seen that allowance is made in the bottom and in both sides of the gutter. This seam allowance was also made in all lap seams as shown. Having thus obtained the stretchouts, the piece of paper on which they were laid off was laid on the ends of the sheets and the points pricked into the iron. Fig. 156 represents the three sheets of iron of which one shed was made. The paper stretchout sheet, Fig. 153, was laid on the left hand end of sheet No. 1, Fig. 156, with stretchout $o\ o^1$ about ¼ inch back from the end of the sheet, and the points pricked through; then stretchout $c^2\ c^3$ was pricked on the right hand end of the sheet in a similar manner; then stretchout $c\ c^1$ was transferred to the left end of sheet No. 2, and stretchout $d^2\ d^3$ pricked on the right hand end; then stretchout $d\ d^1$ was transferred to the left end of sheet No. 3, and stretchout $e^2\ e^3$ on the right hand end. Stretchout $e\ e^1$ was of course used on the left hand end of the adjoining sheet of the next water shed, and the process continued inversely.

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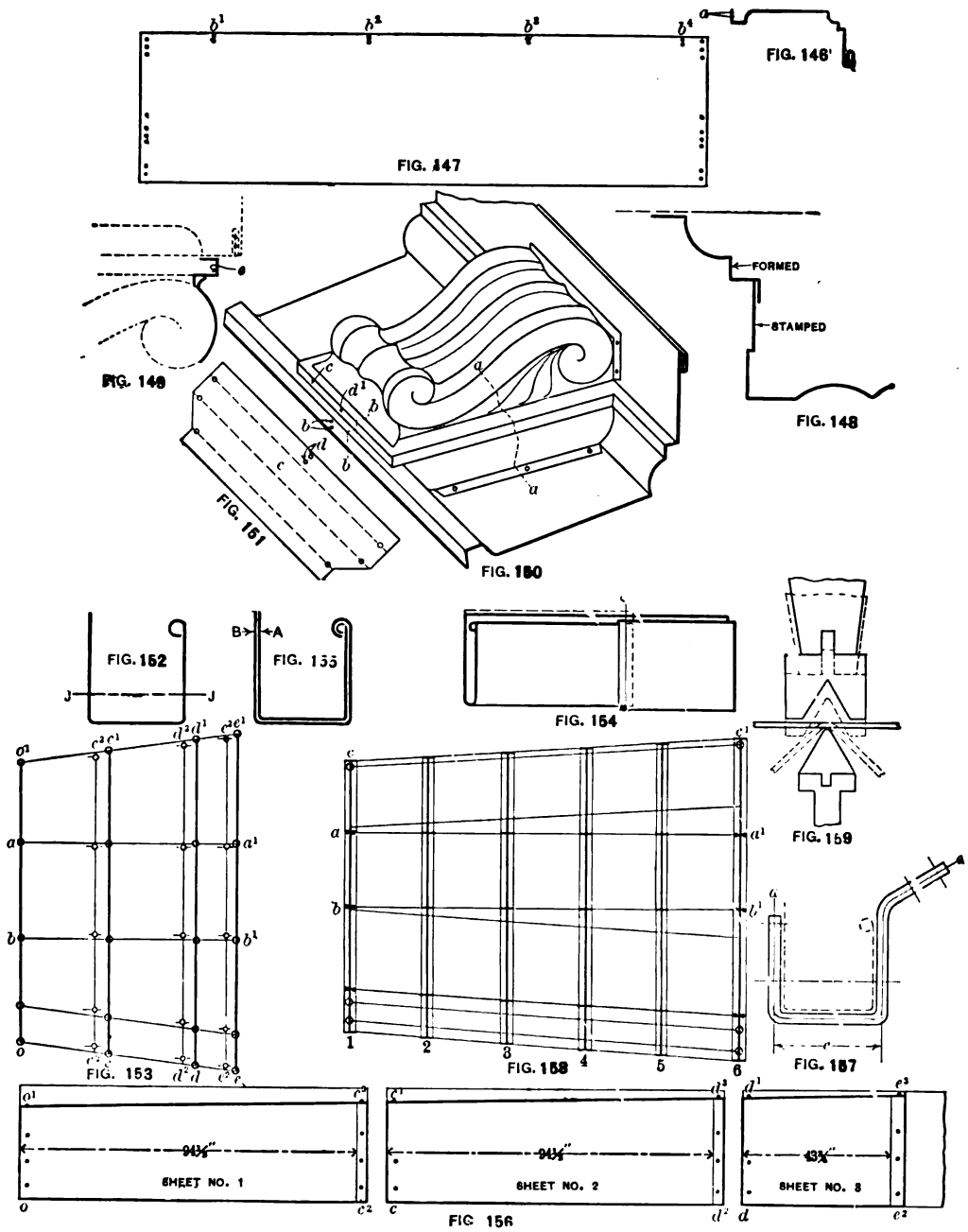
The lengths of the sheets Nos. 1, 2, 3 was, of course, taken from the layout, Fig. 138. The dimensions shown being net the laps are allowed in addition to



Method of Preparing Cornice Moldings and Cornice Gutter

same. After the sheets were thus pricked marked, they were cut to the proper width, which prepared them for the 8-foot upright power brake.

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In getting out the wrought iron gutter hangers a full size detail of the hanger was taken from the full size cornice and gutter detail, represented by Fig. 135, as indicated in Fig. 157. Owing to the thickness of the hanger it was necessary to draw the center line *a a*, from which to take the stretchout. The stretchout of the different hangers in a water shed was obtained as follows:

Referring to Fig. 158, *a a'* and *b b'* were drawn parallel to each other and spaced a distance apart equal to *c*, in Fig. 157. Line 1, Fig. 158, was then drawn perpendicularly across *a a'* and *b b'*, and the stretchout of the hanger, No. 1, Fig. 139, laid off thereon, as indicated. Lines 2, 3, 4, 5 and 6 were then drawn, being spaced to a 1½-in. scale, in accordance with the layout, Fig. 139. The stretchout of the hanger No. 6, Fig. 139, was then laid off in line 6, Fig. 158, and lines *c c'* and 1, 6, Fig. 158, drawn, cutting the intermediate lines. The holes and bends in the hangers are then taken from the detail represented by Fig. 157, and spaced on stretchout lines 1 and 6, Fig. 158, as indicated. Lines were then drawn connecting corresponding points in No. 1 and No. 6, which located the holes and bends in 2, 3, 4 and 5. These lines were then exact stretchouts through centers of hangers. Lines were then drawn on each side of these center lines, spaced half the width of the hanger therefrom, and the stretchout sheet, represented by Fig. 158, was then laid on the bar iron and the cuts, holes and bends center-punched through the paper into the material, and each hanger immediately die-stencil marked, after which the material was cut and punched.

The hangers were bent up cold with special dies in a 5-foot upright power brake, as indicated in Fig. 159, the bends being rounded so as not to break or unduly strain the fiber of the metal. It will be seen at a glance that bending in a brake in this manner saved most of the time, which would have been consumed in heating, and bending in a vise, or otherwise by hand, and was easier and quicker than using an ordinary brace bender.

Fig. 160 represents a cross section of the awning gutter, showing method of hanging, and Fig. 161 the train shed valley gutters, and Fig. 162 is a section of the court cornice and gutter, which receives the water from the special steel frame skylight. The inside edge of the court cornice gutter had a 5-8 inch lock edge turned on it, as indicated at *a*, and the finishing piece *b*, was locked to it and notched out to fit around the bottom of the skylight bars, as indicated; after *b* was secured by clips *c* the seam was closed down with a heavy mallet. Fig. 163 represents a cross section through one of the skylight bars and Fig. 164 shows how the glass was secured at the bottom to prevent sliding down.

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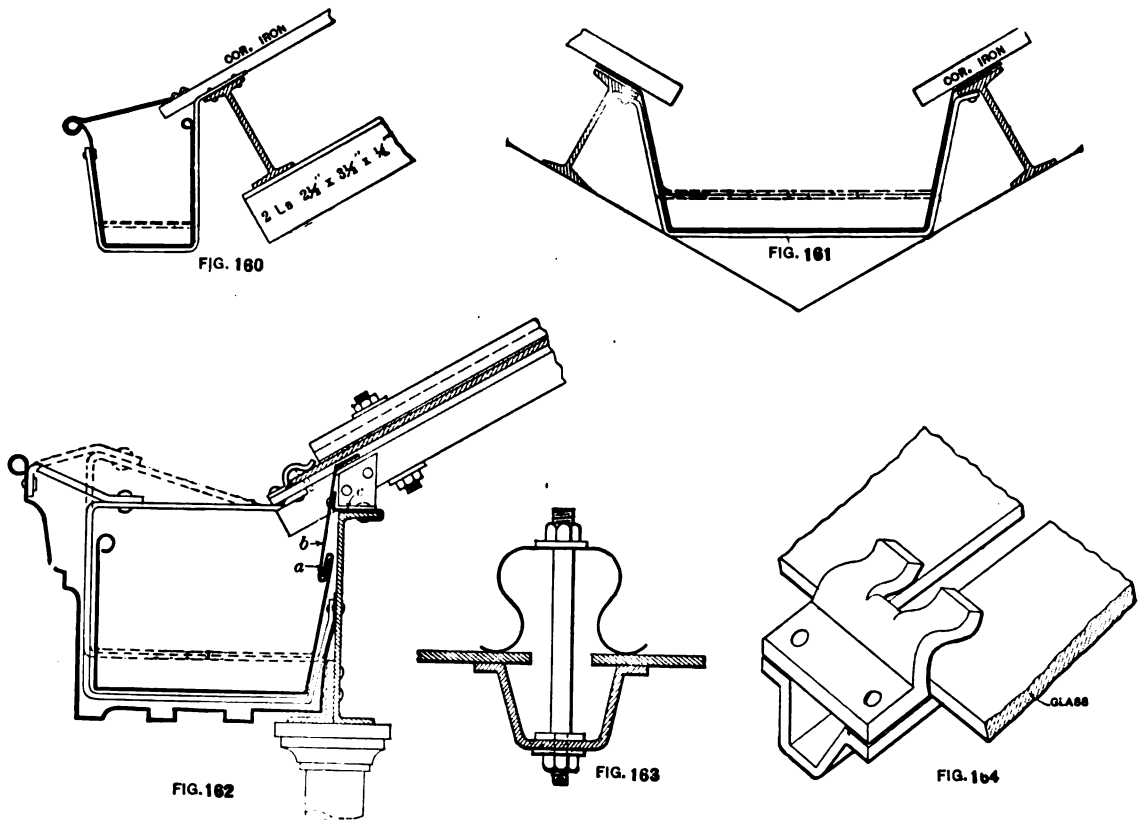
The last three gutters, with their hangers, were planned and got out in the same manner that the main cornice gutter was, except that the bottom bend lines of the gutter, corresponding at *a a'* and *b b'*, Fig. 153, were not parallel, and similar



Some of the Special Gutters and Details of Skylight Work

lines of the hangers, corresponding to *a a'* and *b b'*, Fig. 158, were also converging, as the bottoms as well as the sides of these gutters tapered.

In these gutters the distance *a b*, Fig. 153, was equal to width of bottom of gutter at highest point, and *a' b'* equal to width at lowest point. In Fig. 158 *a b* was equal to the width of the bottom of the highest hanger and *a' b'* equal to the bottom width of the lowest hanger. Otherwise the entire process of laying out and getting out was similar to that above described.

EAVE FINISH FOR METAL ROOFS

Herewith is presented a number of methods for securing sheet metal roofs at the eaves. A very simple method is shown in Fig. 165, where the tin is bent

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over the roof boards and nailed. This manner of securing the tin is very defective, as the underside of the roof boards are unprotected, and, unless the tin extends below the edge of the roof boards, capillary attraction will cause water to be drawn between the tin and the boards. In Fig. 166, the tin is bent down and out so as to form a drip, and while this form appears to be an improvement on the previous one, the underside of the roof boards being unprotected, there is a chance for either wind, fire or water to enter. In Fig. 167, is presented a method that finds favor with many tinners. A strip of galvanized iron is nailed along the eaves, and over this strip the tin is laid and locked over the edge. This does not form either a fire or wind proof finish, as the underside of roof boards are unprotected. In Fig. 168, the roof tin is so formed as to reach under the roof boards and cover them, and if the space between brick and roof boards is well filled with mortar or cement, a tight joint will result. As shown in Fig. 169, strips of tin are so formed as to extend under the roof boards, and at the same time project sufficiently to allow the roof tin to be hooked on, thus protecting the under side of the roof boards and forming a drip. In Fig. 170 the roof tin is so formed as to produce a drip, the tin being secured to the roof boards by nailing. In Fig. 171 the roof

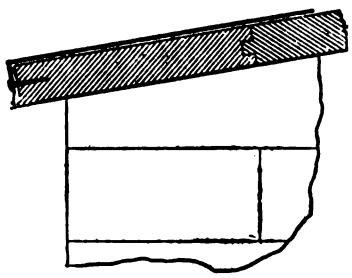

Fig. 165.—Single Bend in Tin

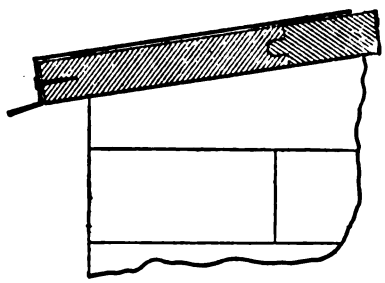

Fig. 166.—Double Bend in Tin

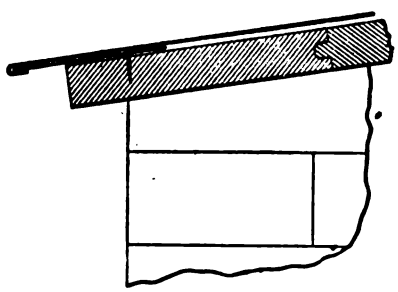

Fig. 167.—Sheet Iron Nailed to Roof

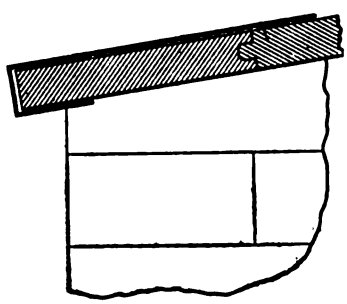

Fig. 168.—Tin Bent Under Edge of Roof

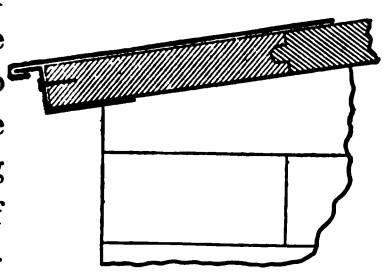

Fig. 169.—Drip Formed by Bent Strips of Tin

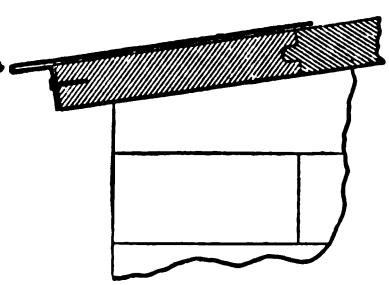

Fig. 170.—Drip Formed in Roof Tin

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tin is bent in such a manner as to form a drip, and at the same time extend under the lower part of the roof boards. Strips of tin can be formed, as shown in Fig. 172, and placed under the eaves, being secured by nailing. The roof tin is then to be hooked on and double seamed over. It is to be understood that these methods are applicable to the linings of box gutters.

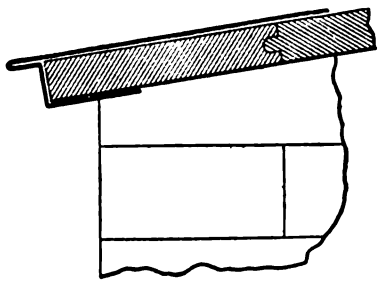

Fig. 171.—Tin Bent Under Roof Board

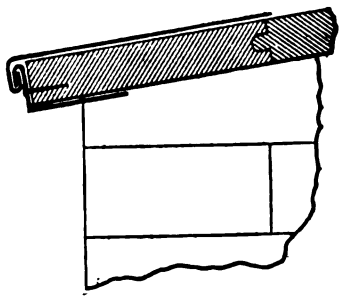

Fig. 172.—Double Seam at Eaves

A ROOFING NOTCHER

It consists of a board 2 inches thick and 10 × 14 in size. At one end of this is fastened securely a piece of tool steel, one edge fitted as a cutting edge, and attached to one end, by means of a bolt with a countersunk head, is the other blade of the shears, which terminates in a short handle. The upper blade is so bent that a very slight movement opens the jaws of the shears sufficiently to insert a sheet of roofing tin. The upper blade is connected with an upright support by means of a spring which keeps the shears continually open. Guide plates are screwed to the board, as shown, so that the sheet of tin to be notched can be pushed up against the guide plates, a corner extending beyond the lower blade of the shears. The spring holding the blade of the shears open, the upper blade can be brought down and a corner of the sheet neatly and correctly cut off, as is required for flat seam roofing laid one sheet at a time. It is a simple matter to attach a rope to the upper blade of the shears so that it can be drawn down by a motion of the foot in a stirrup placed in the lower end of the rope, leaving both hands free to handle the roofing sheets. If the blades are made of heavy and good material, fastened securely together, several sheets may be notched at the same time. It is found in practice

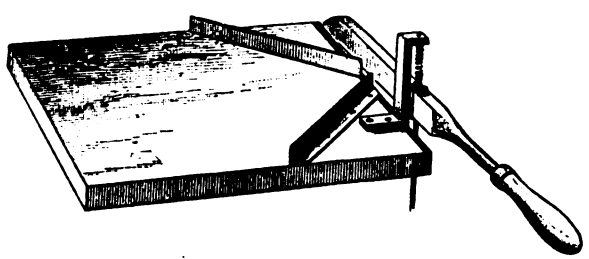

Fig. 173.—A Roofing Notcher

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that a man can notch the roofing sheets more quickly by this means than can be done by either hand or bench shears, and certainly much more accurately.

A DEVICE TO ROSIN ROOF SEAMS

This apparatus, as shown by the illustration Fig. 174, is used to apply the rosin on seams of roofs by filling it with powdered rosin and placing the end with the small hole on the seam and inserting a hot soldering copper in the rosin which then melts and flows through the small hole and on the seam as the device is drawn along.

It is made funnel shape about 4 inches in diameter at the large end, 3-16 inch at the small end and 6 inches long; to this is attached a handle 2 feet long of 1¼-inch band iron.

Fig. 174.—Rosining Roof Seams

STORING LADDERS AND SCAFFOLDS

Herewith is presented a method of storing ladders and scaffolds in length from 20 to 28 feet. As the space in the shop was limited, a novel idea came to mind, namely, to make the necessary hooks, bands and rollers, and store the ladders or scaffolds underneath the floor beams, or, in other words, hang them beneath the ceiling. The illustrations herewith presented will show how this was accomplished. In Fig. 175 is shown the front and sectional views of a ladder hanger, the ladder being placed at right angles to the beams. A, in the sectional view in Fig. 175, indicates the wooden beam; B, the sectional view of the 3-16 × 1¼-inch band iron bracket, which is screwed against the beam A as shown; D and D show the front elevation of the brackets, screwed to the beam C. The width of the ladder J being known, the brackets D and D are spaced accordingly, so as to allow the ladder or scaffold play room to slide in or out, as shown. E represents a ½-inch iron rod placed through the brackets D and D as shown.

By boring or drilling two ⅛-inch holes at each end of the rod E, two pins, H and H, are placed in it to prevent the rod from slipping out of the brackets when putting up the ladders. Before placing the rod E through the brackets a 5-8-inch gas pipe (inside measure) is slipped over it, as shown at F, and forms a roller, which lightens the work of sliding the ladders in place. L, Fig. 175, indicates

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a stationary hook made of 3-16 × 1¼-inch of band iron, twisted half way around, as shown, and screwed fast to the wooden beam. M is a twisted hook fastened to the beam with one long wood screw, which acts as a pivot, and allows the hook to be swung outward when desired. To hang a long ladder, say 25 feet in length, the brackets D and D and hooks M and L would be placed about 20 feet apart. To slide the ladder between the ceiling with hardly any trouble whatever proceed as follows: Raise one end of the ladder up from the floor until it rests upon the pipe F Fig. 175, then raise the other end of the ladder, being careful always to

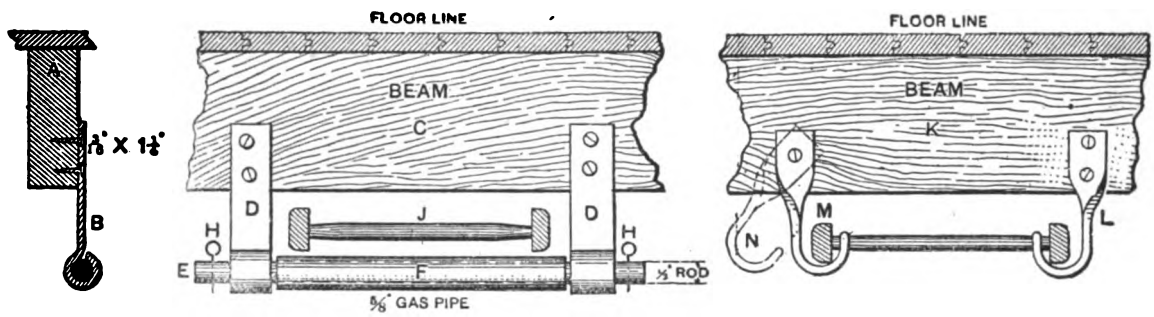

Fig. 175.—Front and Sectional Views of a Ladder Hanger, Hung Crosswise to the Beams

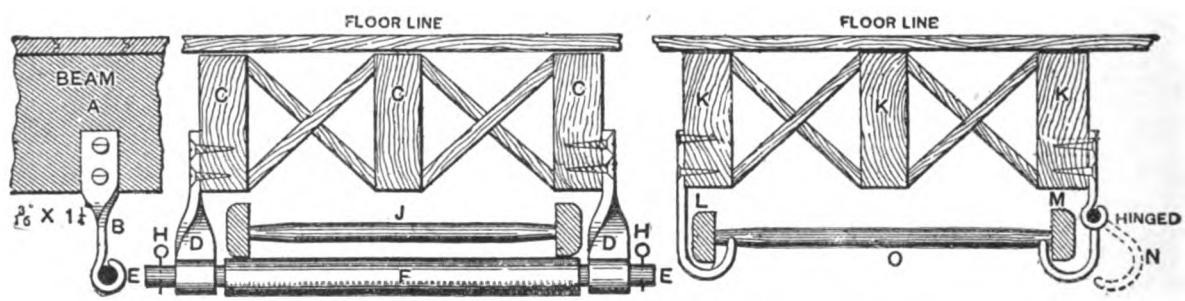

Fig. 176 —Front and Sectional Views of a Ladder Hanger, Hung Parallel to the Beams

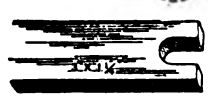

Fig. 177.—Spruce Lifter

press toward the pipe F, as the tendency is to slide out; now, holding it up at arms' length, obtain a spruce slat 1¼ × 3 inches in thickness and long enough to reach the ceiling, have a groove cut in one end of the slat, as shown in Fig. 177, and placing the groove under one of the rungs of the ladder, raise it slowly, always pressing toward the pipe F, until it sets in the stationary hook shown at L in Fig. 175; now press the hook N forward by means of a strip of wood to the position M, which secures the ladder.

When taking down the ladder or scaffold the same operations should be performed reversed. Fig. 176 shows the front and sectional views of a ladder

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hanger, the ladder being hung parallel with the beams; whereas in Fig. 175 the ladder hung at right angles with the beams. The only change required in this case is that the brackets shown at D and D in Fig. 176 require twisting, as shown, and the hook shown at M in Fig. 176 must be hinged so as to allow it to work back and forth.

SUGGESTIONS FOR LAYING SLATE ROOFING

There was a time in the history of slate roofing when it was considered a definite trade, and guarded so jealously in its details that the slater did slate work only. When tin work was required, such as valleys, flashings, etc., the tinner was called on to execute it. During the last decade or more, however, all has been changed in this, as well as in work of other character, and there are now more tinners doing slate roofing than legitimate slaters, and we desire to say at the very outset that what follows is intended more especially for the benefit of the numerous roofers and tinners who have had no experience or opportunity to learn slate roofing, while at the same time it may interest and meet the approval of old slaters.

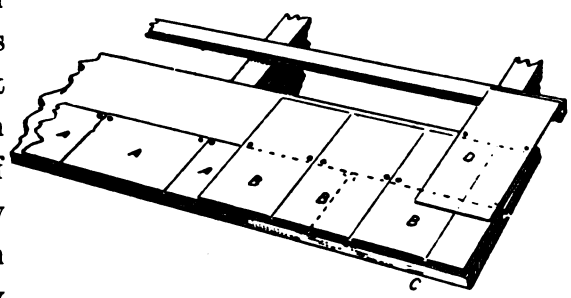

Fig. 178.—Method of Laying Slate at the Eaves

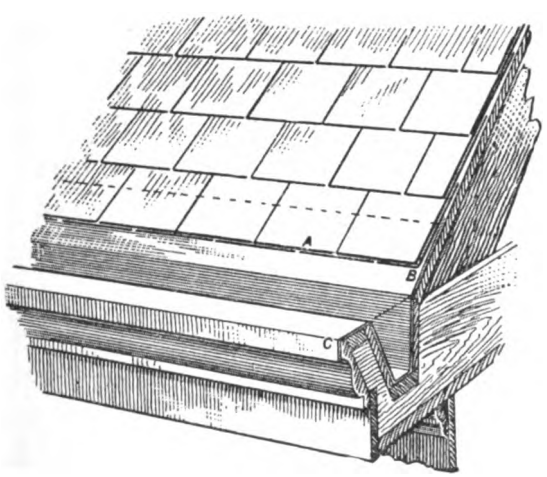

Fig. 179.—Lining a Cornice having a Gutter

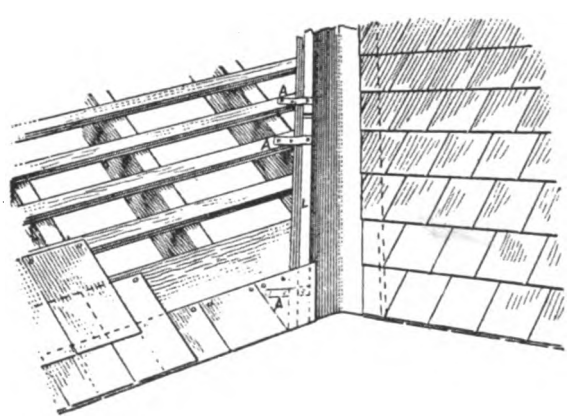

Fig. 180.—Showing a Valley in a Roof

The better sizes of slate are considered as varying from 10 × 20 to 12 × 24, the smaller size for dwellings and small buildings, the larger for factories and barns.

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A good size for a medium roof and one easy to lay is 11×22, giving $9\frac{1}{2} \times 11$ exposed surface. However, in a great many localities a 2-inch lap on the third course is given instead of 3 inches, which would make the exposed surface 10×11. Of this we will speak later.

The object of using an even multiple of length by width is to be able to break joints evenly in length by the width when required. Slate of different lengths may be used on the same roof when necessary, if the width is the same, and the length equal throughout any one course. This is done by regulating the lap of the slate so that they all have a lap of 3 inches at the bottom over the nails driven to hold the second course below them.

The only exception to this is at the eave, where the bottom or eave course is laid lengthwise, as shown by A A, Fig. 178, from gable to gable. The next or second course covers the bottom course, edging with it at the eave, and lying lengthwise up the roof, but starting with a half width slate, bringing the joint, as shown at C, after which whole slate will break joints throughout the row, as shown by B B. The next or third course D is started with a full width slate, breaking joint over B B and lapping $1\frac{1}{2}$ inches over the top edge of the bottom eave slate, as shown. The next or fourth course is started with a half width slate. Continue alternating until the comb has been reached. Three inches are usually allowed for the third under lap, and slate quarrymen and dealers send enough pieces to the square to lay a full square allowing the lap referred to, yet in some localities where quality is sacrificed for price, a 2-inch lap only is given, making a saving of $\frac{1}{2}$ inch to each course of slate, apparently trifling, yet amounting to 30 square feet in two sides of such a roof as that shown in Fig. 181. The size of the roof being 20×14 feet 10 inches and the size of the slate used being 10×20 inches, the roof will require 21 courses, with 24 slates to the course, with 3-inch lap. With a 2-inch lap less than 20 courses will cover the same surface, a saving of 48 slates 9×10, equal to 4320 square inches, or 30 square feet, or approximately 5 per cent, a small gain for inferior workmanship.

The color of the slate to be used must be determined by the customer. Black is a color that will not fade and is very desirable. A good quality is found in the Bangor district in Pennsylvania. Unfading green, sea-green, purple, variegated and red are quarried in Vermont and north New York. Red slates are unfading, but they are too expensive to use except in working out such a design as that shown by Fig. 181, in which the red slates are shaded lighter than those supposed to be black or green. This design requires only 48 to either side of the roof.

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A pleasing combination for figure or design work is made by using purple for the figure and unfading green for the body. Sea-green looks well when new, yet the liability to fade and form all manner of grotesque figures, renders it unreliable. Sea-green is the cheapest slate for roofing purposes, and the monotony or sameness may be broken, when it is used exclusively, by running courses of the slate with the corners cut, as at A and A in Fig. 181, alternating with slate having square corners. The soundness or quality of the slate may be determined by a slight tap of the hammer in laying. If a clear ringing sound is given out you can depend on their being perfect. If defective, black slate break lengthwise, green slate through their width.

Slate from the quarry must be in carload lots to get the best freight rate, and as it is rated at 600 pounds a square, 40 squares—12 tons—is a minimum carload. Unless one has contracts calling for more, as a start, this amount may be divided into 30 squares green and 10 squares of purple, size 11 × 22, which is not too large for a small building or too small for a larger one. It is good stock and can be realized on at any time. No matter, however, what size or color you prefer, do not order less than a carload, as local freight rates on slate are ruinous to profits.

Too much care can not be taken in lining a cornice having a gutter, as illustrated in Fig. 179. No matter what metal it may be lined with, galvanized iron, after copper, an important item is to have the back part of the gutter at B higher than the front C, the first course of slate to be laid 2 or 3 inches higher up the roof than a point level with the front as shown at A. This is to provide against an overflow into the building in case of freezing and snow thus forcing the overflow in front in case of an emergency, especially when the conductor pipe has become clogged. To prevent the latter, wire strainers should be placed in all outlets. All the metal of the roof gutter above the first row of slating nails is useless; nails, in short, should not be driven through the metal at all, as the expansion and contraction of the metal will work holes the larger, and if not high enough leakage will follow. Capillary attraction and nail holes have been the cause of hundreds of unexplained leakages.

A valley in the roof is shown by Fig. 180, one side of which has the slate laid complete, and has the eave course started on the left side showing the slate projecting over a common plastering lath "L," laid along the edge of the valley over the metal to give the valley course of slate the proper elevation at their butts. The lath is held in place by means of strips of galvanized iron nailed to them as

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at A A. These strips are nailed back of the edge of the valley and not through the metal. The slate can project over the lath an inch and the lath be placed 5 inches from the center of the valley on each side, giving 4 inches of exposed valley on each side of the center. To get an even edge it is best to use chalk and line it.

For hip and comb finish it is good economy to use a ridge roll, as illustrated

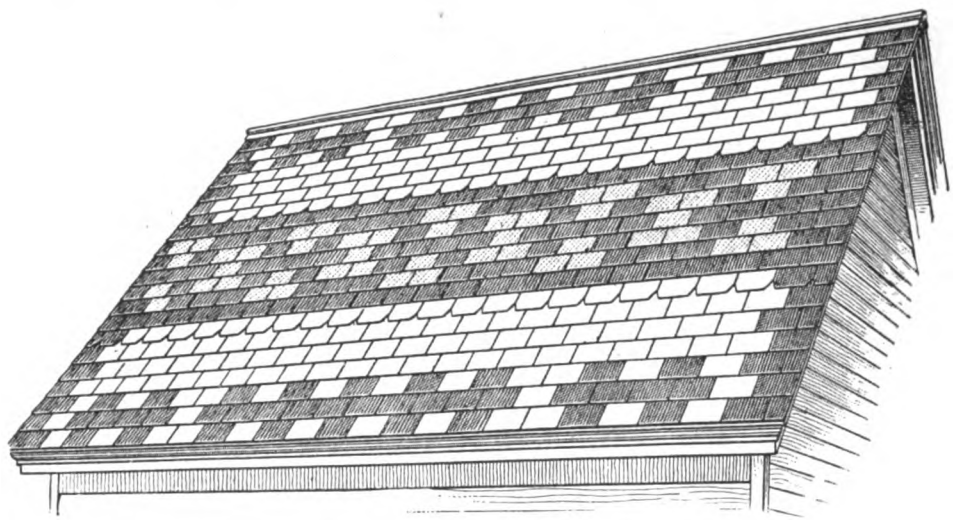

Fig. 181.—Roof Showing use of Slate of Various Colors, Forming what is known as the Double Maltese Cross Design

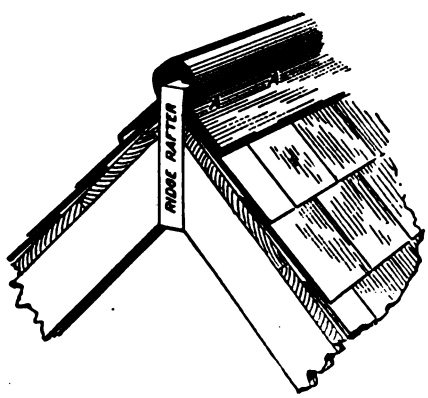

Fig. 182.—Hip and Comb Finish

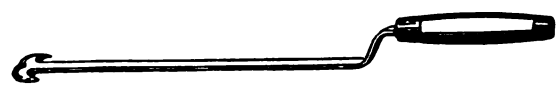

Fig. 184.—A Slater's Ripper

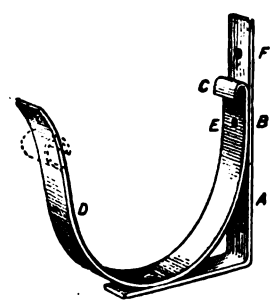

Fig. 183.—Style of Eaves Trough Hanger Recommended

in Fig. 182. The comb or ridge rafter should project above the roof sheathing an inch to allow the cap to be nailed to it, as shown at A and A, and also against which the slate may abut.

Flashing, chimneys, fire walls, skylights or places where the roof abuts against another building are proceeded with in the same way as in tin or shingle roofs, the slate being cut to the required size and shape.

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The roof foundation may be either lath $\frac{7}{8} \times 3$ inches or 4 inches, or solid sheathing. If lath are used they will have to be spaced so that the top of the rows of slate will rest on the center of the lath, the bottom slate having a 3-inch lap over the top of the second course below, as shown by Fig. 178. If the size of the slate is 10×20, this will give an exposed area of 85 square inches to each slate, or measuring surface of $8\frac{1}{2} \times 10$.

Unless very cheap work is desired it is at all times advisable to use common sheathing, surfaced on one side, placing the rough side up; this, covered with slater's felt, will prevent sleet, snow or driving rain from being forced into the garret. Slate should not bind at the side edges, as it will prevent drainage between the slate and induce breakage by freezing in cold weather.

If laths are used upon which to lay the roof, the bottom or eave should be sheathed solid for at least three courses, to provide a solid base for the eave trough hangers, etc. A hanger free from the roof is undoubtedly preferable, and such is shown in Fig. 183, which can be made in the shop of hoop iron and of a gauge suitable for the purpose intended; that is, it does not require as heavy iron for a $3\frac{1}{2}$ inch hanger as for 6 or 7 inches. The band D is formed in the rolls after the hole E has been punched or drilled, after which the hook C is formed by turning the end down $\frac{1}{4}$ inch to receive the back edge of the trough. The front is slightly curved as shown; the strap is then riveted to the brace A, having two screw holes at B and F, which completes the shop work on it. In hanging the trough a brace is placed at each end of the roof, secured to the fascia board, or the end of the rafters, by means of wood screws; one "F" above the hook C and one engaging both the strip D and the bracket A at the holes E and B. The bracket at the outlet being lower than the one at opposite end provides for the pitch and a line stretched from the bottom of one to the other provides a gauge for the placing as many more in the intermediate as may be deemed necessary. The trough is laid in the bracket, using care to have its back edge the engage hook C, Fig. 183. When the strip D is formed over the bead in front, as shown by the dotted lines, the hook C and the formation over the bead will keep the trough in shape and position; its advantages are an unobstructed flow, strength, and the avoidance of nailing through the slate.

A set of slater's tools requires but small outlay, a handy blacksmith being able to make all required. However, a set bought from a dealer is generally better proportioned and the additional cost so slight that it is advisable to buy from the latter. A slater's hammer, a ripper, shown in Fig. 184, a stake and nail punch

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are required. A home-made hammer can be made by welding a steel point to the blade of a hatchet, as at Fig. 185.

A steep roof requires scaffolding. The brackets may be made out of scrap pieces of wood to be found around a new building, as shown in Fig. 186. The

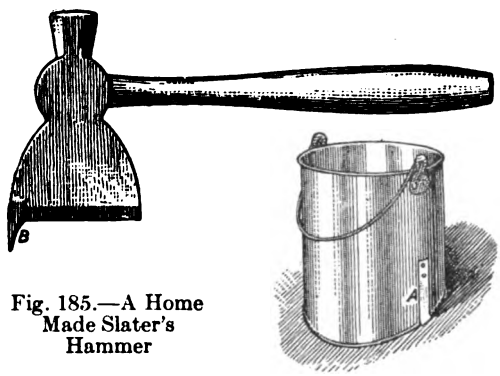

Fig. 185.—A Home Made Slater's Hammer

Fig. 189.—A Roof Paint Bucket

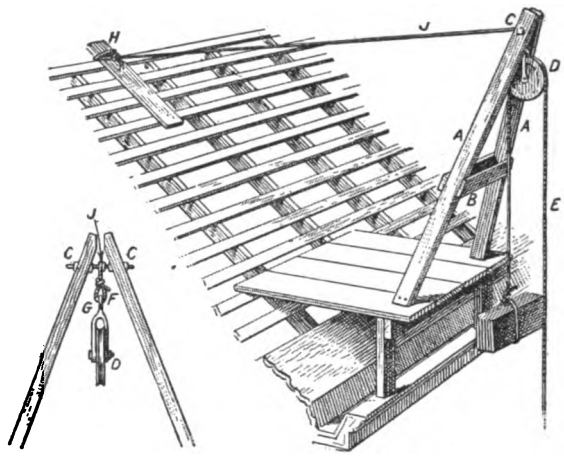

Fig. 187.—Details of one Form of Derrick used in Raising Slate to Roof

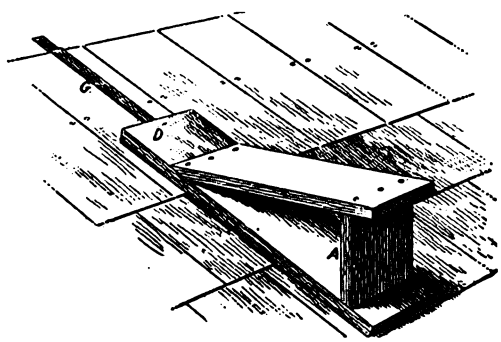

Fig. 186.—A Scaffold Bracket for Slaters' Use

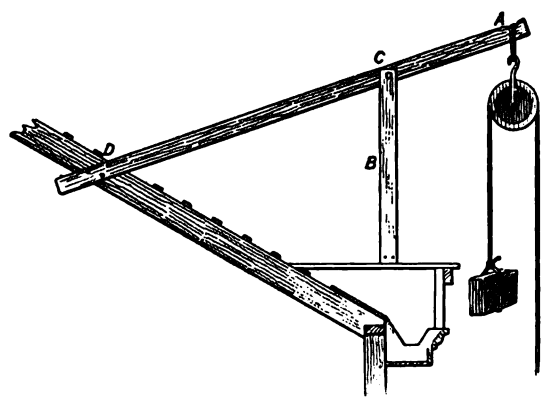

Fig. 188.—A Projecting Beam Derrick

pitch of the bracket is regulated to conform with the pitch of the roof by the length of the standard support A. The bottom board need not be longer than from 16 to 18 inches. A galvanized iron strip, G, is nailed on the under side of it at D, and is of a length to reach over the top of the last course of slate laid, approximately 18 inches; and to allow the front of the bracket to be down the roof far enough not to interfere with the lap of the next course of slate to be laid, the brackets are distributed across the roof, nailed to the sheathing by means of the galvanized strips, and common 10 or 12-inch sheathing boards are laid on top of them,

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from which to work. Slates are laid upon the boards and stacks of slate are piled immediately above the brackets, and the number of brackets required for safety must be determined by the workmen. The slate is laid up the roof, over and regardless of the galvanized iron strip, and when the roof is completed the bracket is removed by placing one hand on the slate over the galvanized iron strip and bending the strip close up to the bottom of the slate, when it will break off, freeing the bracket.

A device for raising slate to the roof is shown by the derrick illustrated in Fig. 187. This derrick is made with 2×4 standards, A A, 7 feet long. Two boards, 1×4 inches, are nailed, one on each side of the standard near the center B, and of such a length as to spread the standards 3 feet at the bottom and 6 inches at the top. The top rod, $\frac{1}{2}$ inch, will secure the standards firmly by using nuts and washers both inside and outside, which are drawn up tight, as shown at C C in the detail sketch at the left. The rope J with the loop F is tied around the rod and taken to the comb of the roof, where it is coiled around the board H, which is nailed and projects over the opposite side of the comb, as shown. The wheel D, or iron sheave as it is commonly called, shown at D in Fig. 187, is made after the style of a bicycle rim, but of iron, and about 1 foot in diameter. A bolt passes through it, to which a forked rod is attached, on the end of which is the hook G, which engages the loop F of the rope J. The rope E should be of a length that will allow both ends to touch the ground after passing over the wheel D. A small chain may, if desired, be attached to the end of the rope engaging the slate, which will not allow the slate to slip as easily as a rope. Two men can elevate the slate with ease with this derrick, which is secured on the roof by means of a platform. This platform may be about 4 feet long by 3 feet wide, supported in front so as to make it level, as shown. The standards A A are toenailed to the platform and the top is fastened as has been described with the rope J. The derrick should lean out over the cornice or eave far enough to avoid striking any projection of the building by the slate in being hoisted.

The man on the ground and the one on the platform can both pull on the rope until the slate is high enough to be pulled in and balanced on the center brace B until the rope or chain is loosened, when the platform man gives the rope a downward throw and while he carries the slate to the roof scaffold the man below loads up again.

A projecting beam derrick can be made as illustrated in Fig. 188 and operated as above described, or a horse may be used on the ground instead of man power by

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passing the rope over a snatch block, held firmly to the ground by a stake. The platform may be as already described, the exception being in regard to standards and beam. The latter are made of 2 × 4 oak timber from 10 to 12 feet long, projecting over the eave as at A and passing back of and nailed to a rafter of the roof at D at an elevation giving the desired pitch. It is braced at the platform with two side braces B, which are spread at the bottom, as shown in Fig. 187, and are toenailed and secured to the beam by a bolt at C.

In relaying slate in part, upon a roof undergoing repairs, the row or last course to be laid must be secured by driving the nails between the slate of the row above and covering the nail heads by slipping a strip of galvanized iron over the heads and under the slate.

Or, better still, the last course can be secured in place by nailing strips of sheet metal ½ inch wide, and long enough to extend about 1 inch below the bottom of the slate; then shove slate under the course above and bending the strip over the bottom of slate suspending it in its proper position.

The double Maltese cross design, Fig. 181, is one of the most pleasing designs that can be laid with green and purple slate, having a red relief, as shown by the slate of lighter shade, and withal an easy one to develop. The length of rafters and width of the roof are reduced to inches and the amount divided by the exposed length and width of the slate, giving the number of slate to a course and the number of courses required. When this has been ascertained a rough draft may be made by the workman, similar to Fig. 181, and taken upon the roof, which will show at a glance where each slate on the roof should be located.

In driving nails care should be taken not to draw the slate tight, otherwise freezing weather, followed by a thaw, will crack them, or burst the nail head through, allowing the slate to slip down the roof.

A roof paint bucket made to conform to the pitch of the roof and used in slate roofing for valleys, flashing, etc., is shown in Fig. 189, and may be made in size to conform to the fancy of the workman. For tin or metal roofing, the steel spring band A riveted on each side is intended to engage the standing seam to help prevent the bucket from slipping, and a No. 6 wire across the top, as shown at B, may be used to wipe the brush of excess of paint.

For contract roofing it does not pay to use seconds or No. 2, or do indifferent work, as one poor roof will ruin the reputation of a score of good ones. If a price cannot be gotten that will justify good slate and careful workmanship, it is far better to turn the job down. Your reputation for quality and skill will soon make

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itself manifest and you can get fair prices. It has long been said that the foundation of a house and the roof were the important items to consider, and no one able to build at all will object to a fair price if satisfaction is assured.

In making an estimate see that there is a complete and full understanding as to the terms of pay and guarantee of work. If the roof is in the country, never fail to mention hauling the slate to the work and returning that not used; also terms for board, free or otherwise, for your man and horse or team; also specify the price per square for all tin or galvanized iron work, and also that there be a foot of width added as extra for the length of each hip and valley on the roof. If copper nails are to be used, add 25 cents per square extra, otherwise use common galvanized slater's nails. Ridge roll, Fig. 182, should be used on all hips and over the comb and price per foot specified. As it is almost an impossibility to remember all the items to be considered when taking a contract, each roofer should have some simple printed contract form that he may draw up at his leisure to meet his own views, embracing all items that could probably come under dispute, thereby saving himself possible untold annoyance and oftentimes cash.

A SLATER'S ADJUSTABLE SCAFFOLD BRACKET

These are instructions for making a scaffold bracket which can be adjusted to suit various pitches of roofs, and which has its suspending strip of iron so constructed that it can be slipped from under the slates so as to change it to another place on the roof.

It may be said that roofers care very little for the various patented scaffolds and the many schemes of adjustable brackets. They prefer the well-tried method of making brackets out of scrap pieces of wood to be found around buildings, and hanging them from strips of sheet metal. When the scaffolding is being removed these strips are broken off and the part under the slates is left there.

This method of scaffolding is rapid and safe, while with the strip made so as to allow for withdrawing it from under slates there is the positive danger of inadvertently pushing the brackets up, thereby dislodging the strip from its hold on the nails.

A bracket of this type can be easily constructed as follows: Cut two pieces of 1-inch board 6 inches wide, one 30 inches and the other 25½ inches long, and connect them with strong hinges as shown at D in the diagram. The standard C is a piece of 1-inch board, 6 inches wide and 16 inches long. To keep this

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standard in place 1 × 1-inch cleats are nailed to the base of the bracket, as shown at E, and the standard is fastened to these cleats by bolts through G, which is made of heavy sheet iron and nailed or screwed to the cleats.

The adjustment to two other roof pitches by one standard is shown by the dotted lines. By using different lengths of standards, adjustment to a greater range of pitch is obtained. Plenty of play should be allowed when spacing these cleats, for it is desirable to keep the standards plumb. It has been found that when using different sized standards it may be necessary to put a standard in, say, the first space of the roof piece H and the second space of the platform or plank rest, piece J.

The strip K is made by a tool maker of tempered steel and the notches cut for as many nails as are deemed necessary to support the load. In this case there are

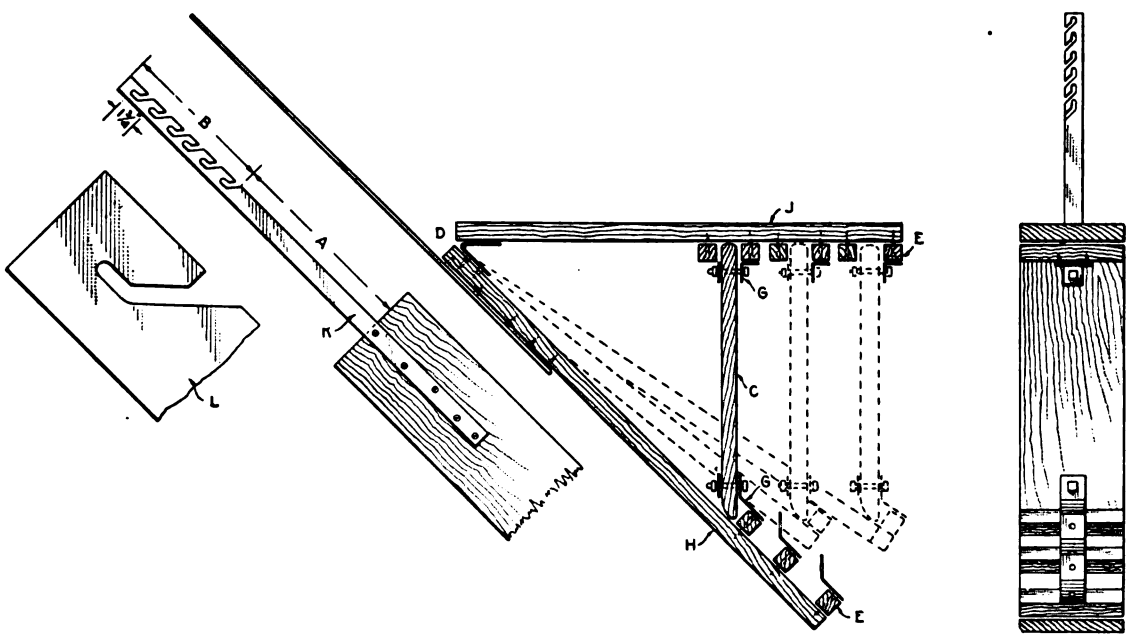

Fig. 190.—Details of a Slater's Adjustable Scaffold Bracket

six. The notch is better shown by L. They are spaced about 1¾ inches. The strip is 2 inches wide and 1-16 inch thick. The length A is such that when bracket is placed on the slates the first notch is above the last course of the slates laid and allows the top of the bracket to be down far enough not to interfere with the top of the next course, and just so low that when the bracket is being released from the nails it can be pushed up just the distance required to be slipped from the nails without the bracket hitting the slates.

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It is suggested that for a very steep roof like a mansard, a scaffold built up from the eaves and tops of the dormer windows be used in preference to these suspended brackets.

A FALSE-BOTTOM GUTTER

When it is desirable to have a small molded gutter show up level and still have the requisite pitch to the leader, and owing to the gutter being small it would not pay to have a wood lined or box gutter, as described in another part of this book; then the accompanying illustration, Fig. 191, should answer.

This gutter is only a molding on the outside, and can be formed up to suit the job, and is nailed to the fascia board at B. This molding is riveted and soldered at the seams, care being taken, when doing this, not to press on the molding, as it s very easy to push the molding at the seam, thereby having it out of line, and of course crooked.

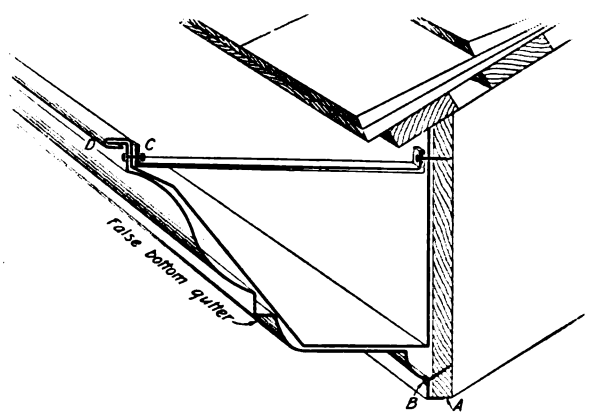

Fig. 191.—View of False Bottom Gutter in Place

After erecting the molding by nailing at B, and holding up the front temporarily, the lining or inside gutter, which has the proper pitch to the leader, is put in, 24 ft. at a stretch, fastening it at D to the molding as shown, and nailing to the fascia in the back. Those seams at the ends of the 24 ft. lengths cannot be readily riveted, therefore, previous to laying in, place these seams together on the ground, looked along the two lengths, and straighten (or use a chalk line). Punch holes as if for rivets, but instead insert 3-16 in. stove bolts, with the nuts on the sides of the gutter, which will be inaccessible when in place; tighten up bolts and solder the nuts, seeing to it that bolts are not soldered; remove the bolts, take the two lengths apart and then they can be set in place in the molding and bolts re-inserted in their places, same as if in a tapped hole, and seams heavily soldered.

This method of making a false bottom has the additional advantages of allowing for a pitch from the very top of molding to bottom, and should the bottom leak it will be manifest by dripping from the molding at A, which should be suffi-

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cient warning to renew bottom before molding becomes rotted also. The braces are made from 1-8 × 1 in. tinned band iron and formed as shown, bolted at C to the gutter and nailed to board at the back. If desired, the bottom could be flanged back on the roof and under shingles or slate, and likewise the brace could be nailed to roof. .

MAKING AN ACID CUP FROM A BOTTLE

Some shops furnish the men with a suitable receptacle for the acid in sheet metal soldering. It being a fact, though, that oftentimes, especially on outside work, the men must find something to hold the acid and to allow of dipping in a brush, the following is presented.

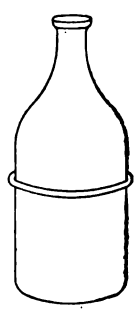
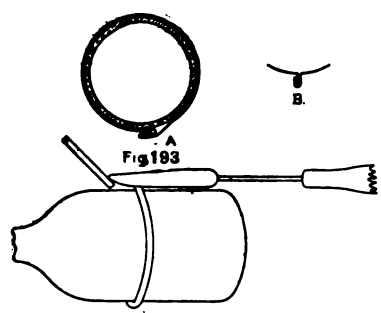


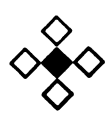
Fig. 192



Method of Making Cup.

Take any clean bottle, such as a beer or soda water bottle, and bind around it a narrow strip of sheet metal as Fig. 192. This strip should be about ⅛ in. wide and bound as tightly as possible with a lock joint by turning with the pliers small edges as B, Fig. 193 and then dressing them down as A, Fig. 193.

After this swab some acid on the strip, and with a hot soldering copper, solder around the strip, using some solder of course, and before the bottle and strip have a chance to cool, put acid on the strip, with the brush following the soldering iron as indicated in Fig. 194. This will cause the glass to split on the line of the strip and a light blow will break the lower half of the bottle from the neck. Sometimes the glass is rather tough and the heating and cooling must be repeated two or three times. This is the conventional manner of making these cups and it takes very little time and is certainly worth knowing.



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